IDENTIFICATION OF SEVERE ACUTE MALNUTRITION AMONG ANGANWADI CHILDREN IN THE VELLORE URBAN ICDS PROJECT AREA

Dissertation submitted in partial fulfillment of the requirement of The Tamil Nadu Dr M.G.R. Medical University

For the M.D. Brach XV (Community Medicine)

Examination to be held in April 2013

CERTIFICATE

This is to certify that "Identification of Severe Acute Malnutrition Among Anganwadi Children in the Vellore Urban ICDS Project Area" is a bona fide work of Dr Verghese Anjilivelil Thomas in partial fulfillment of the requirements for the M.D. Community Medicine examination (Branch XV) of the Tamil Nadu Dr M.G.R. Medical University to be held in April 2013.

Guide	Head of the Department
Dr Kuryan George, MD, M Sc	**Dr Kuryan George, MD, Msc**
Professor of Community Health	**Professor of Community Health**
Christian Medical College, Vellore	**Christian Medical College, Vellore**

ACKNOWLEDGEMENTS

I wish to thank:

Dr Kuryan George, my guide, for directing me towards this research topic and guiding me through this endeavour.

Dr Jasmine Helan Prasad, my co guide, for her guidance and constant practical help.

Dr Anuradha Bose, my co guide, for her advice.

Dr Vinod Abraham for timely enquiries into my progress and for his advice in the thesis write up.

All faculty of CHAD for their advice and the faculty of LCECU for follow up medical services.

Dr Sulochanna Abraham, for her inputs in the thesis write up.

Mr Backiaraj, Vellore ICDS District Programme Officer, for his permission and support which made the training course, survey and medical camps possible.

Mrs Parimala, Vellore ICDS Urban Project Child Development Project Officer, for her help and coordination of the training course, survey and medical camps.

Dr Shoba Sathyaprakash, Medical Officer of the Government Urban Health Centre of Kaspa, for allowing the use of the facilities of the Urban Health Centre for the training course.

Mrs Rajalakshmi, Supervisor in the Vellore ICDS Urban Project, for help in arranging the training course and helping with the survey and medical camps.

Mrs Selvi, Mrs Prema and Mrs Jayanthi, Supervisors in the Vellore ICDS Urban Project, for help in arranging the survey and medical camps.

All the Anganwadi Workers of the Vellore ICDS Urban Project who participated in the training course and survey for their participation, help and enthusiasm.

All the Anganwadi Helpers of the Vellore ICDS Urban Project for their help during the survey.

Mr Pandiraj, for Tamil translation, proof reading and help in Tamil typesetting and desk top publishing of the manual and questionnaire.

Mrs Gifta, Social Worker of CHAD, for Tamil translation and proof reading of the manual and questionnaire.

Mrs Tabeetha, Mr John Paul and Mrs Nirmala for their efforts in Tamil translation.

Dr Sam Marconi, for help in back translation and transliteration of the manual.

the Health Aides of CHAD who participated in the pilot training course.

All my colleagues in CHAD for their help and cooperation.

My father for his practical advice.

My mother for her support.

Nelia, my fiancé, for her constant encouragement.

The parents and children enrolled in the Vellore ICDS Urban Project, for making this undertaking meaningful.

ACRONYMS

AWC	Anganwadi Centre
AWW	Anganwadi Worker
AWH	Anganwadi Helper
CDPO	Child Development Project Officer (of ICDS)
DALY	Disability Adjusted Life Year
HAZ	Height for Age Z-score
HUNGaMa	Hunger And Malnutrition report
IAP	Indian Academy of Pediatrics
ICDS	Integrated Child Development Services scheme
MAM	Moderate Acute Malnutrition
MDG	Millennium Development Goal
MUAC	Mid Upper Arm Circumference
NCHS	National Centre for Health Statistics
NFHS 3	National Family Health Survey 3
NRHM	National Rural Health Mission
RUTF	Ready to Use Therapeutic Food
SAM	Severe Acute Malnutrition
TALC	Teaching Aids at Low Cost
WAZ	Weight for Age Z-score
WHO	World Health Organization
WCGS	World Health Organization Child Growth Standards
WHZ	Weight for Height Z-score

CONTENTS

ANNEXURES:

1. Christian Medical College Vellore Institutional Review Board approval
2. Originality Certificate
3. Letter to Tamil Nadu ICDS Principal Secretary/Special Commissioner
4. Weighing Scale
5. TALC MUAC insertion tapes
6. Infantometer/Height board
7. WHO Weight-for-Height Growth Charts for ages 2 to 5 years
8. Task Analysis
9. Course Curriculum
10. Lesson Plans
11. Training Manual
12. Knowledge Assessment Questionnaire
13. Practical Assessment OSPE Checklist
14. Anthropometric Data Proforma
15. Demographic Data Proforma
16. Child Health Card

1 INTRODUCTION AND JUSTIFICATION

Malnutrition is a major contributor to child mortality in India. In 1995 it was estimated that up to 67% of child deaths in India were attributed to malnutrition (1). Studies in 2003 and 2004 have found that malnutrition is a contributing factor in 56% of all child deaths in developing countries (2). Wasting is a form of under nutrition in which the expected weight for a given height is not achieved, is due to acute malnutrition. Severe wasting is considered an important nutritional risk factor for other causes of death in children but can also be seen as a disease in itself. The WHO and UNICEF have defined Severe Acute Malnutrition (SAM) for the purpose of identifying severely wasted children who require nutritional and medical therapy. In 2006 the WHO released Child Growth Standards for which it has been shown that the risk of mortality for children with weight for height below -3 standard deviations of the median of the reference population is 9.4 times higher than that of children with weight for height above -1 standard deviation from the median of the reference population(3). Mortality among children with less than 115 mm mid upper arm circumference (MUAC) has also been found to be higher than among those with MUAC above 115 mm(4). Since 2009 the WHO and UNICEF have adopted these cut offs together with the clinical sign of pedal edema to define severe acute malnutrition(5) which have been found to detect more children with wasting, as well as identifying wasting at an earlier and more remediable stage than while using weight for height cut offs of the NCHS reference population (6).

India has the largest number of children suffering from severe wasting in the world and the largest share of severely wasted children among all countries in the world(7). The NFHS 3 anthropometry survey found that among children aged less than 5 years surveyed 6.4 % in India on the whole and 8.9 % in Tamil Nadu were found to have severe wasting. (8).

The Integrated Child Development Scheme (ICDS) is the Government of India's flagship child development programme. One of the objectives of the ICDS III project of the Government of Tamil Nadu is 'To improve the nutritional and health status of children in the age-group 0-6 years'(9). The ICDS operates through a cadre of Anganwadi workers (AWWs) who run Anganwadi centres (AWCs) in which children in the 0 to 6 year age group receive growth monitoring, supplementary nutrition and early childhood education in order to promote growth and development. The Anganwadi Workers currently monitor growth and detect under nutrition by measuring weight for age. The ICDS of Vellore Urban project area has the reach within the community to provide nutritional assessment and supplements for a large proportion of children who are at risk of being malnourished in Vellore because children attending the Anganwadis are mainly from the lower and lower-middle socio economic strata of society. NFHS 3 found that 97 percent of children less than 6 years in Tamil Nadu lived in enumeration areas covered by an Anganwadi centre and 41.6 percent of those children had received services from the Anganwadi centre within the 12 months preceding the survey(8).

Research is required to determine the extent and validity to which the identification of severe acute malnutrition can be taught to Anganwadi Workers of Vellore and implemented in the ICDS programme of Vellore ICDS Urban Project Area. This knowledge will inform policy on detection of malnutrition carried out throughout the ICDS, thereby reducing the contribution of malnutrition to child mortality. The prevalence of SAM in the Vellore Urban ICDS Project area needs to be determined to quantify the significance of acute malnutrition among children as a public health issue in Vellore.

2 OBJECTIVES

The objectives of the study were:

1. To train Anganwadi Workers of Vellore Urban Integrated Child Development Scheme project area to identify Severe Acute Malnutrition among children attending Anganwadi Centres of the project.
2. To validate the identification of Severe Acute Malnutrition carried out by Anganwadi Workers.
3. To determine the prevalence of Severe Acute Malnutrition among children attending Anganwadis in the Vellore Urban ICDS project area.

3 LITERATURE REVIEW

3.1 Malnutrition in Childhood

Malnutrition is a pathological state which results from an abnormal intake of nutrients. An inadequate dietary intake of energy and protein results in under nutrition or protein energy malnutrition. An excessive energy intake results in over nutrition. An inadequate intake of specific micronutrients and minerals results in micronutrient deficiencies. Thus the term malnutrition has a broad application and may refer to any one of the three conditions mentioned.(10) However, in common usage the term malnutrition is used interchangeably with under nutrition and so in this dissertation the term 'malnutrition' will hereafter refer to under nutrition or protein energy malnutrition, unless otherwise specified.

Childhood Malnutrition is of significance because of its significant contribution to mortality and morbidity. Childhood is a period of rapid growth and development which requires a high protein and energy intake and consequently children are especially vulnerable to the ill effects of malnutrition. Malnutrition makes children more vulnerable to infectious diseases and is a contributing factor currently associated with more than one third of all deaths among children below the age of 5 years across the world.(11)

3.2 Classification of Malnutrition

Malnutrition can be classified biochemically, clinically (qualitatively) or anthropometrically (quantitatively). For quantification of malnutrition in communities and for planning preventive measures a quantitative classification according to the severity of malnutrition is required. Anthropometry is used to provide this classification(12).

3.2.1 Anthropometric Classification of Malnutrition

Malnutrition in childhood is classified anthropometrically into 3 forms(12)(13):

1. **Wasting** – the child has a low weight compared to that expected of a healthy child of the same height and sex. It results from acute malnutrition (12) and may result from an acute shortage of food as is seen in emergency settings such as wars and natural disasters. In non emergency settings it results from underlying medical conditions(13).

2. **Stunting** – the child has a low height for their age and sex. It is a failure to achieve the biological potential for growth. It results from chronic malnutrition and is the result of past malnutrition(12)(13).

3. **Underweight** – the child has a low weight compared to healthy children of the same age and sex. It may be due to wasting or stunting or both and is thus a composite of wasting and stunting.

3.2.2 Clinical Classification of Malnutrition

Different clinical classifications of Protein Energy Malnutrition are available. The commonly accepted Wellcome classification classifies children as being Undernourished, Kwashiorkor, Marasmus or Marasmic Kwashiorkor(12). The classification is according to the following criteria:

Table 3.1 Welcome Classification of Protein Energy Malnutrition

Weight for age %age of reference standard	Oedema	
	Present	Absent
80 - 60	Kwashiorkor	Undernourished
<60	Marasmus	Marasmic Kwashiorkor

Kwashiorkor and Marasmus are severe forms of protein energy malnutrition and have very high rates of morbidity and mortality.

3.3 Quantification of malnutrition

3.3.1 Z-score system of quantifying malnutrition

Wasting is measured by the weight for height index (W/H), stunting by the height for age index (H/A) and underweight by the weight for age index (W/A). The severity of malnutrition is quantified by comparing a child's index with that of a healthy reference population. The accepted method used now is to assign a Z-score, also known as a standard deviation score. The Z-score of a particular child is the number of standard deviations below or above the median of the healthy reference population that the child's anthropometric index lies(14). This can be summarized in the following formula:

$$\text{Z-score (or SD-score)} = \frac{\text{(observed value of child - median value of the reference population)}}{\text{standard deviation of reference population}}(5)$$

Thus a child whose weight for height index has a value that lies one standard deviation below the value of the median weight for height index on the reference population will have a Z score of -1. A child whose weight for height has a value which lies two and half standard deviations above that of the median of the reference population has a Z-score of 2.5.

3.3.2 Notation of Z-scores

1. Weight for Height Z-score is abbreviated as 'WHZ'
2. Height for Age Z-score is abbreviated as 'HAZ'
3. Weight for Age Z-score is abbreviated as 'WAZ'

3.3.3 Mid Upper Arm Circumference (MUAC)

Mid Upper Arm Circumference (MUAC) is an anthropometric measure which is used to measure wasting. It is the circumference of the upper arm at the midpoint between the acromion and the olecranon process(15). It is measured in the left arm. During acute malnutrition the mass of muscle and subcutaneous fat in the arm decreases, resulting in a decrease in MUAC, allowing for a quantification of malnutrition. The MUAC is age and sex independent between the ages of 6 months to 5 years and has been used in the field setting as a surrogate for measuring weight and height because of its simplicity and acceptability(4).

3.4 Global and Regional Prevalence of Childhood Malnutrition in Developing Countries

Globally in 2010 there were an estimated 20 million children who were severely wasted, 171 million who were stunted and 104 million who were underweight. (11) Childhood malnutrition is strongly linked with poverty and infectious disease(3,11,16) and so globally its prevalence is higher among the Low and Middle Income Countries as is illustrated in the pictures below.

Figure 1 Global Distribution of Prevalence of Childhood Wasting 2011 (17)

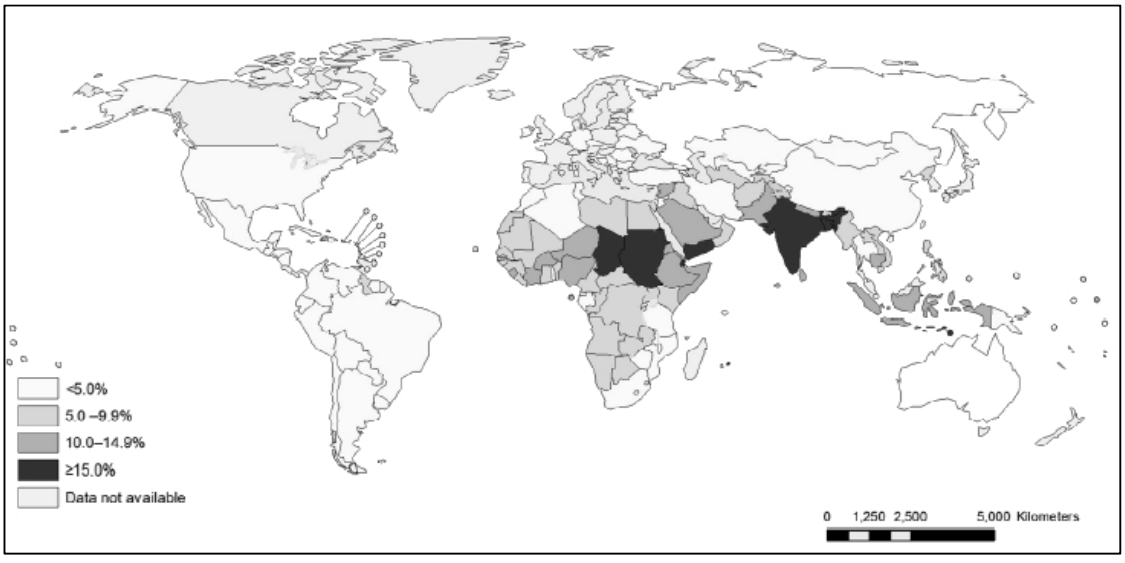
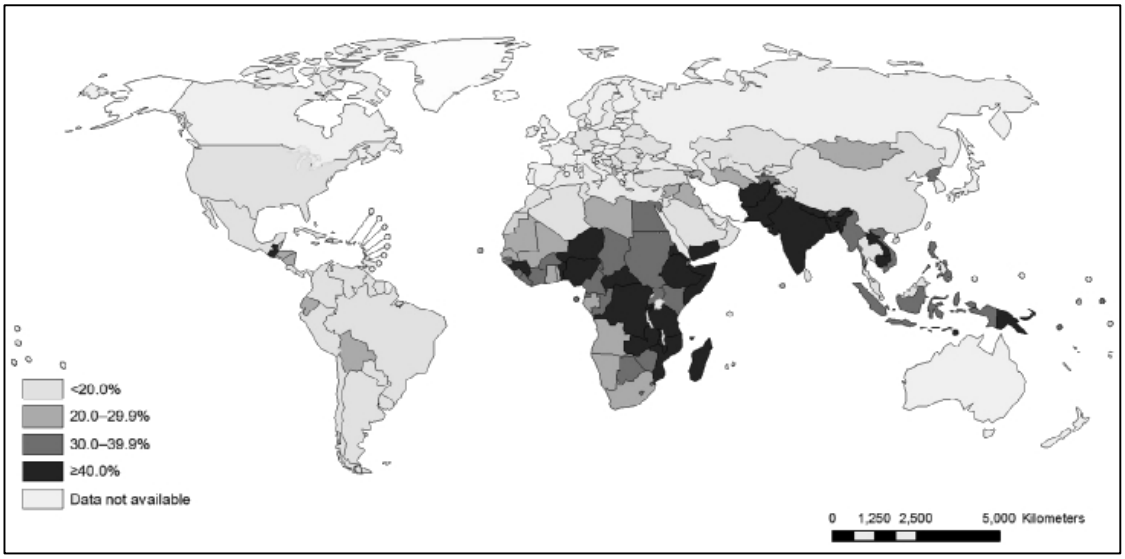


Figure 2 Global Distribution of Prevalence of Childhood Stunting 2011 (17)



Figures 1 and 2 indicate that childhood malnutrition is prevalent mostly in low and middle income countries. They also show that India occupies a prominent position in terms of the prevalence of wasting among children.

An analysis of 388 nutritional surveys done in 139 countries estimated that among all children below the age of 5 years in low and middle income countries in 2005 the prevalence of underweight children was 20.2% (corresponding to 112.4 million children), the prevalence of stunting was 32.0% (affecting 177.7 million) and the prevalence of severe wasting was 3.5% (19.3 million children) in which underweight and stunting were defined as a WAZ and HAZ less than -2 according to the 2006 WHO Child Growth Standards (WCGS) and severe wasting as having a WHZ less than -3 on the WCGS. The global prevalence of wasting (weight for height less Z score less than -2) among children under 5 years was estimated to be 10%.(3)

Regional prevalence of malnutrition in 2005 among developing countries in different UN regions varied(3). The highest prevalence of underweight children was in South Central Asia

and Eastern Africa (33 % and 28 % respectively). The highest prevalence of stunting occurred in Eastern and Middle Africa (50 % and 42% respectively) although the largest number of children with stunting resided in South Central Asia – 74 million children. The highest prevalence of wasting was in South Central Asia (16 % representing 29 million children). The highest prevalence of severe wasting was also in South Central Asia (5.7 % corresponding to 10.3 million children). Thus it can be seen that among all the developing countries in Latin America, Africa and Asia, South Central Asia is affected by childhood malnutrition the most.

India has the largest share of global childhood malnutrition. It has been estimated that out of all the malnourished children in the world, 49 percent of the underweight children, 34 percent of the stunted children and 46 percent of the wasted children reside in India.(18) In 2003 approximately 62% of the world's severely wasted children resided in India giving India the number one rank in the world for severe wasting in terms of number of children affected (7).

3.5 Prevalence and Trend of Childhood Malnutrition in India

The National Family Health Survey 3 was done in 2005 – 2006 and included an anthropometric survey of children below 5 years of age. The 2006 WHO Child Growth Standards were used to classify the degree of malnutrition. The overall prevalence of malnutrition in the samples across all states sampled was 19.8% for wasting, 6.4% for severe wasting, 48.0% for stunting and 42.5% for underweight(8). The NFHS 2 was done in 1998 – 1999 and anthropometry was done for children below the age of 3 years. The data obtained in NFHS 2 was reanalyzed to reclassify the malnutrition found according to the 2006 WHO Child Growth Standards to obtain the following comparison of prevalence of malnutrition among children below the age of 3 years(8) shown in the following table.

Table 3.2 Prevalence of malnutrition in children below 3 years age in India in NFHS 2 and NFHS3

	NFHS 2 1998 – 1999	NFHS 3 2005 – 2006
WASTING (Weight for Height Z score < -2)	19.7%	22.9%
STUNTING (Height for Age Z score < -2)	51.0%	44.9%
UNDERWEIGHT (Weight for age Z score < -2)	42.7%	40.4%

The prevalence of stunting has decreased and the prevalence of underweight children has decreased marginally but there has been a small increase in wasting between the two surveys.

More recently, the HUNGaMa report was released in 2011, presenting data from an anthropometric survey done between October 2010 and February 2011. The survey was done by the Naandi Foundation of Hyderabad for the Citizen's Alliance Against Malnutrition. 1,09,093 children below the age of 5 in 3360 villages of 9 states covering 112 rural districts were surveyed. 100 of these districts were the lowest ranking districts according to the Child Development Index that is used by UNICEF India. These districts were termed 'Focus Districts' and were found in the sates of Bihar, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh . In addition to the focus districts, the best district from each of the six focus states was also surveyed, and finally the 2 best districts of the in the 3 top ranking states (Kerala, Tamil Nadu and Himachal Pradesh) were also studied. The results are shown in the following table (19):

Table 3.3 Prevalence of malnutrition in children under the age of 5 in HUNGaMa report 2011

	Prevalence in 100 focus districts	Prevalence in 6 best districts from focus states	Prevalence in 6 best districts of the best states
Wasting (Weight for height Z score < -2)	11.4%	12.4%	13.5%
Stunting (Height for age Z score < -2)	58.8 %	43.3%	32.5%
Underweight (Weight for Age Z score < -2)	42.3%	32.6%	21.9%

It can be seen that the prevalence of malnutrition on the whole in India is high. Reacting to the prevalence of underweight in the focus districts, Prime Minister Manmohan Singh described the current situation as a "national shame" when he released the report in January 2012(20).

3.6 Prevalence of Childhood Malnutrition in Tamil Nadu

In 2005 – 2006 the NFHS3 surveyed 6344 rural and urban households in Tamil Nadu(8) and the prevalence of the different types of malnutrition found are given below in comparison with the prevalence found across all states:

Table 3.4 Prevalence of malnutrition in children below 5 years in India and Tamil Nadu NFHS3 2006

	All India	Tamil Nadu
Severe Wasting (Weight for Height Z score < -3).	6.4%	8.9%
WASTING (Weight for Height Z score < -2)	19.8%	22.9%
STUNTING (Height for Age Z score < -2)	48.0%	30.9%
UNDERWEIGHT (Weight for age Z score < -2)	42.57%	29.8%

The mean Z score for weight for height in children in Tamil Nadu was -1.0. Compared to the national average, Tamil Nadu fares better in terms of stunting. But in wasting the prevalence is higher in both severe wasting and total wasting.

From the above literature it can be seen that childhood malnutrition has a high prevalence in India with a considerable proportion of children being wasted. The prevalence of stunting and underweight is less in Tamil Nadu, but they are still unacceptably high. The prevalence of wasting in Tamil Nadu is similar to the rest of India, being marginally higher.

3.7 Effects of Childhood Malnutrition

3.7.1 Short term effects

Childhood malnutrition has considerable short term effects on childhood morbidity and mortality. The total percentage of child deaths (of children aged 1 – 4 years) attributable to childhood malnutrition through its potentiating effects on infectious diseases was estimated to be 67% in India in 1995(1). The global percentage of childhood deaths (under 5 years age) attributed to malnutrition in 2004 has been estimated to be 14.6% for wasting, 14.5% for stunting and 19.0 % for underweight(3). The main causes of death from the end of the neonatal period to the 5^{th} year of life are pneumonia, diarrhea and malaria(11). From an analysis done on mortality data from 8 low income countries (including India) the risk of mortality from pneumonia, diarrhea and malaria has been shown to increase with decreasing Z score of WHZ, HAZ and WAZ (3). Thus malnutrition contributes to mortality by increasing the pathological effects of infectious diseases.

The overall global disease burden from malnutrition in under 5 children has been estimated as 64.5 million DALYs for wasting (14.8 % of DALYs in under 5 children), 54.9 million DALYs for stunting (12.6% of DALYs in under 5 children) and 81.4 million DALYs for underweight (18.7% of DALYs in under 5 children) in 2004 (3).

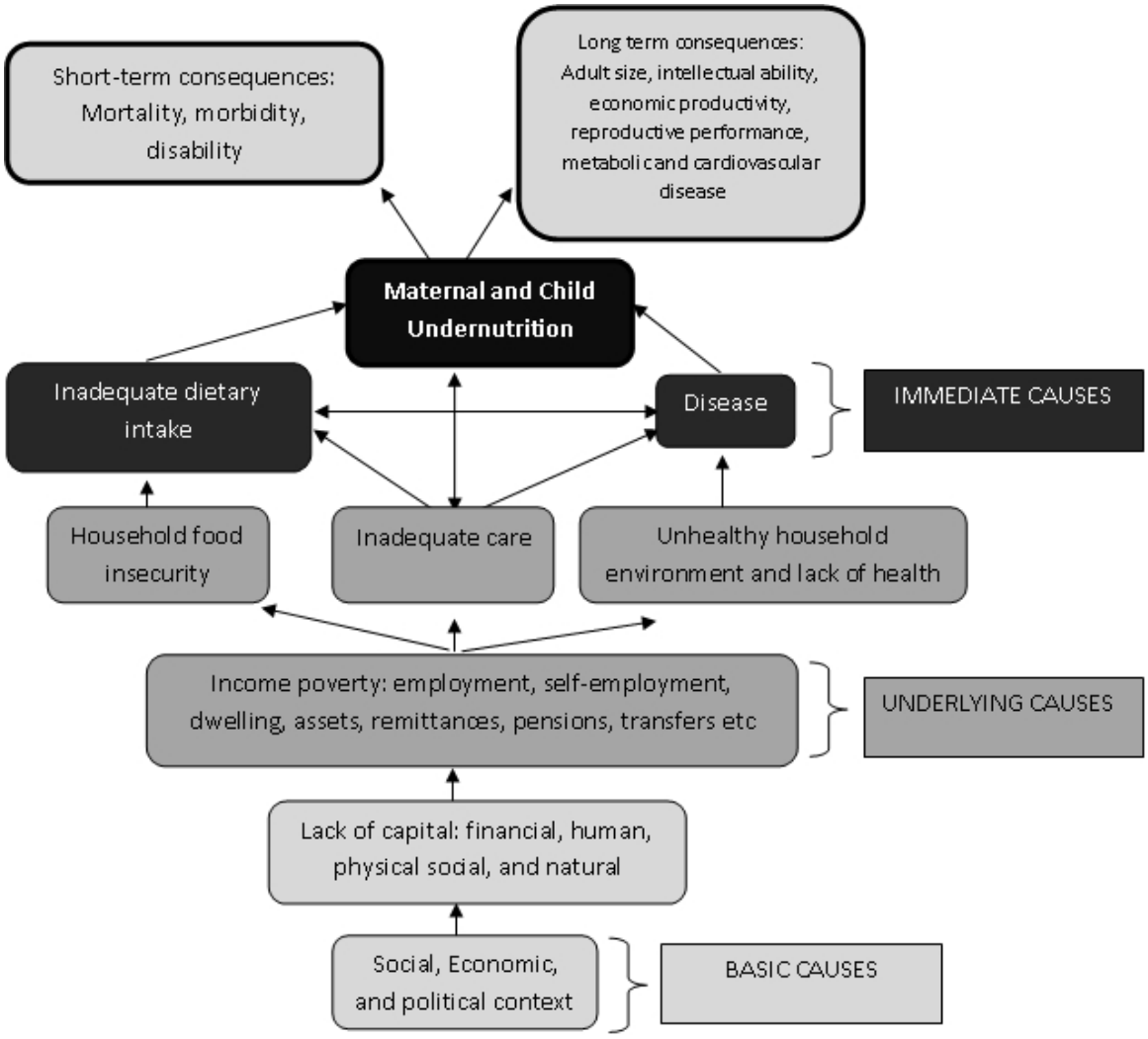
3.7.2 Long term effects

Malnutrition also has long term irreversible effects on physical development resulting in reduced cognitive ability, school performance(16) and reduced adult size(3). In women maternal short stature is associated with cephalopelvic disproportion (3) which results in morbidity or mortality in women and neonates. Low maternal body mass index is associated with intra uterine growth restriction(3) which is a factor in low birth weight, infant mortality and further malnutrition in successive generations. Thus each generation's nutritional status influences the nutritional status of successive generations and a self perpetuating cycle of malnutrition persists across generations (21)

3.8 The Significance of Malnutrition in Economic Development

In addition to its considerable impact on child health, childhood malnutrition is also a significant factor influencing economic development of populations as a whole. Childhood malnutrition is associated with infectious diseases and poverty in a 'vicious cycle' where in each contributes to the persistence and worsening of the others(10)(21). Malnutrition not only increases (and is increased by) diseases, it also affects the economic productivity of individuals and communities within the population and so itself leads to poverty. A summary of the causes and effects of malnutrition is presented in the diagram below:

Figure 3Web of Causation of Maternal and Childhood Malnutrition with its Short term and Long term effects. (Adapted from "Maternal and child under nutrition: global and regional exposures and health consequences" (3)



3.9 Childhood Malnutrition and the Millennium Development Goals in India

Childhood malnutrition forms a part of the Millennium Development Goals directly in MDG1 and indirectly in MDG4. It is estimated that India will fall far short of meeting the targets of both these goals in 2015(22)(23). MDG1 has a target of reducing the prevalence of childhood malnourishment by 50%. The target for India is to achieve a prevalence of 28.6 % underweight children by 2015. It has been estimated that India may achieve a reduction from

53% in 1990 to 40% by 2015. By this estimate India will fall far short of the target. MDG4 has a goal of reducing of childhood mortality by two thirds by 2015. Reducing childhood malnutrition is crucial to reducing child mortality in India(7)(24). The current under 5 mortality rate is 74.6 per 1000 live births and this is expected to decrease further to 70 per 1000 live births by 2015(23). This rate falls considerably short of the target of 42 per 1000 live births.

In the light of these statistics it becomes obvious that a considerable reduction in childhood malnutrition is required in India to achieve its Millennium Development Goals and thereby, development.

3.10 Reducing Childhood Malnutrition in India

Malnutrition can be addressed at the basic and underlying cause of poverty. However reducing poverty through economic growth alone takes time and can not bring about the reduction in malnutrition required in the short or medium term (16) (7). Also, India has achieved a moderate reduction in poverty towards its MDG1 but during the same period the reduction in childhood malnutrition (also a part of MDG1) has not changed considerably(22). Therefore while an inter-sectoral approach towards a reduction in poverty is necessary to improve childhood malnutrition, the urgent response required to address childhood mortality requires attention to the immediate and specific causes of childhood malnutrition: inadequate dietary intake and disease.

3.10.1 Specific interventions for malnutrition

Underweight is a composite of wasting and stunting. These two forms of malnutrition require different interventions as they have different etiologies(12). So when addressing the interventions required for childhood malnutrition it is more useful to consider wasting and stunting individually without clubbing them together in the category of underweight.

3.10.1.1 Treatment of Stunting

Stunting is irreversible and so interventions to reduce stunting have to be preventive. This includes promotion of healthy complementary feeding through education and provision of food supplements (24).

3.10.1.2 Treatment of Wasting

Interventions for wasting vary according to severity and clinical condition. All children with severe wasting require nutritional supplementation and medical treatment(25). Severe wasting with medical complications requires hospital admission with management in 2 phases: an acute or stabilization phase and rehabilitation phase(26,27). During the acute phase life threatening complications such as biochemical derangements, fluid imbalances and infections are treated. Then feeding to achieve catch up growth is initiated in the rehabilitation phase. According to recent WHO guidelines severely low weight for height without medical complications can be managed in the community by health workers with regular visits to health centres (16). The cornerstone of this recommended management is feeding with Ready to Use Therapeutic Food (RUTF) after medical complications have been ruled out by a health worker according to Integrated Management of Childhood Illnesses guidelines(25) . RUTF has been shown to be more effective than previously used feeds in facility based interventions for acute malnutrition (24). In the community based setting it has been shown to induce weight gain during humanitarian emergencies (24). Current IAP guidelines recommend facility based care for all children with severe wasting. The Ministry of Health And Family Welfare (MOHFW) has published guidelines for setting up Nutritional Rehabilitation Centres (NRCs) at health facilities for children with severe acute malnutrition to be admitted and treated by a dedicated and highly trained team(28). For children without the option of admission, the IAP has put out guidelines for home based care but cautions that

its guidelines "should be considered exploratory in nature pending validation, especially under programmatic conditions" (29)

3.11 A Reduction in Severe Wasting is Required to Reduce Child Mortality in India

In order to reduce child mortality in India specific attention towards the severe forms of acute malnutrition is required because of the prevalence of wasting and the high risk of mortality from severe wasting (7)(24). The risk of mortality for children with severe wasting is considerably higher than that of severe stunting and moderate wasting. The odds ratio for mortality for severely low weight for height (Weight for Height Z-score less than -3 of WHO Child Growth Standards) is 9.4 as compared to 4.1 for severe low height for age, 3.0 for moderately low weight for height and 1.6 for moderately low height for age.(3) Case detection of acute malnutrition is necessary to treat acute malnutrition in childhood. Identifying children who are at risk of mortality due to severe wasting and treating them before life threatening medical complications arise is required to reduce the considerable mortality and morbidity caused by severe wasting.

3.12 The Need for Community Based Case Detection of Severe wasting

In India identification of children with severe wasting is predominantly done in medical facilities by highly trained medical professionals because the treatment of severe malnutrition has always been by hospital admission. In recent years the management of severe wasting has been carried out at the community level in emergency settings in parts of Africa (25,30) resulting in the development of case detection guidelines that can be used at the community level by field workers(5). Because acute childhood malnutrition has such a high prevalence in India, community based case detection is required to meet the challenge of identifying the large numbers of children in India who have acute malnutrition and can benefit from the

therapies available. Currently the IAP and Ministry Of Health and Family Welfare recommend that peripheral health workers – Anganwadi Workers and Auxiliary Nurse Midwives – identify children with severe acute malnutrition and refer them for verification at higher levels in the health care system(28,29). At present the Integrated Child Development Services Scheme (ICDS) carries out growth monitoring by measuring weight for age but children with wasting may be missed. Hence the need and for community based identification of severe acute malnutrition has been recognized and guidelines for the same are already in place.

3.13 WHO Guidelines for the Identification of Severe Acute Malnutrition (SAM)

In 2009 the WHO and UNICEF defined Severe Acute Malnutrition (SAM) for the purpose of identifying children who are at greatest risk of mortality due to severe wasting and who would benefit the most from special nutritional therapy(5). Severe acute malnutrition is defined for children aged 6 to 60 months and the diagnostic criteria are:

1. Weight for height Z score less than -3 of the 2006 WHO Child Growth Standards OR
2. Mid Upper Arm Circumference less than 115 mm OR
3. Bilateral pedal edema

If any one of these criteria are fulfilled then a child is classified as having severe acute malnutrition (SAM).

The above definition of SAM is a modification of the 1999 WHO definition of severe malnutrition. Previously severe malnutrition was defined as a child having a weight for height below -3 standard deviations of the NCHS reference and/or pedal oedema(5). Bilateral pedal oedema was included so that children suffering from Kwashiorkor can be identified. Children

with Kwashiorkor may have a normal weight for height in spite of being malnourished because of fluid retention. This fluid retention may mask a low weight for height but will manifest as bilateral pedal edema which is a clinical sign(4).

The significant changes in the definition of SAM are the change of reference population from the NCHS reference to the 2006 WHO Child Growth Standards and the inclusion of MUAC with a cut off of 115 millimetres.

3.13.1 Effect of using WHO Child Growth Standards to Define Severe Acute Malnutrition

A fundamental change in the new definition is the change in the reference standards used to classify the severity of low weight for height. The 2006 WHO Child Growth Standards replaced the National Centre for Health Statistics (NCHS) reference which has been used since 1977.

3.13.1.1 The WHO Multicentric Growth Reference Study 1997 - 2003

The 2006 WHO Child Growth Standards (WCGS) are the product of the WHO Multicentric Growth Reference Study conducted between 1997 and 2003. In this study approximately 8500 children from 6 countries (India, Ghana, Brazil, Oman, Norway and USA) who had been exclusively breast fed for their first 6 months and raised under optimum conditions were measured in a standardized way(31). The resulting standards describe how healthy children should grow between the ages of 6 months and 5 years.

In 2008 the Ministry of Health and Family Welfare and the Ministry for Women and Child Development adopted the WHO Child Growth Standards for use in nutritional assessment in the NRHM and ICDS(32)

3.13.1.2 Effect of adopting the WHO Child Growth Standards on prevalence of SAM and implications for nutrition programmes

The change in the reference standards changed what is accepted as the physiological norm and so changed the cut-offs that were used to assign nutritional status to children. These changes have significant implications for nutrition programmes because the cases identified as malnourished by the NCHS standards and the WCGS are not the same. The prevalence of malnutrition and severe malnutrition are different using the WCGS and the NCHS statistics are different and the number of children eligible for treatment differs. Studies have shown that using the WHO standards results in a 2.5 times increase in prevalence in severe acute malnutrition compared to using the NCHS reference whereas prevalence of moderate and mild acute malnutrition (WHZ score < -2 and <-1 respectively) do not differ (33,34). This results in an increase in children who are eligible for feeding programmes, approximately 4 times more children will be eligible (35) than when using the NCHS reference population.

3.13.1.3 Effect of adopting the WHO Child Growth Standards on treatment outcome for children with acute malnutrition

A study in Niger was done to determine the differences in response to treatment when using the WHO standard compared to NCHS standard (where severe malnutrition was taken as weight for height less than 70% of the NCHS median) to enroll children in nutritional therapy programmes.(6). This study found that approximately 8 times more children were identified as having severe wasting using the WHO Child Growth Standards. These children had a higher weight for height and were younger. The treatment duration was shorter, recovery rate was higher and referrals for hospital admission were less. This suggests that using the WHO standards identifies severely malnourished children who have a high risk of mortality at an earlier and more treatable stage compared to the NCHS standards.

3.13.2 Effect of using the 115 mm mid upper arm circumference cut off to define SAM

In previous definitions of acute malnutrition a cut off of 110 mm was used to differentiate between severe and moderate wasting(4). However children with an MUAC of less than 115 mm have a high risk of mortality(36) and results from the WHO Multicentric Growth Study showed that very few (<1%)healthy children aged 6 to 60 months in a well nourished population would have an MUAC of less than 115 mm. Hence the cut off for MUAC was changed from 110 to 115 mm to identify more children who had higher risk of mortality due to Severe Acute Malnutrition.

3.13.3 Advantages of the new definition of SAM

The change in cut offs used in the definition has been justified through the following properties of the new classification:

1. A high risk of mortality exists for children with weight for height Z-score <-3 of the WHO standards compared to children with weight for height Z-score >-1, the odds ratio for mortality being 9.4. (3)

2. Children identified as having SAM have a higher weight gain when receiving special therapeutic diets than when receiving other diets (24).

3. This diagnostic criteria has been shown to be highly specific as less than 1 % of children aged 6 to 60 months in a healthy population would have a weight for height Z score of less than -3 or a Mid Upper Arm Circumference of less than 115 mm(5).

4. There are no known adverse effects associated with therapeutic feeding given to children identified as having SAM according to the recommended protocols(5)

3.14 Community Based Case Detection of SAM in India

The need for community based case detection of SAM, the recommended guidelines and the workers designated for the task – Anganwadi Workers – has been established thus far. Reports detailing Anganwadi Workers carrying out this function have not been found in medical literature. A report of Anganwadi workers being used to identify children with SAM in Udipi Taluk of Udipi District was published by The Hindu newspaper in July 2012. Using Anganwadi Workers for case detection, 370 children from 1046 Anganwadis and 213 children among 9020 children who were not enrolled in Anganwadis were identified as having SAM and started on treatment(37). Studies to determine the validity of case detection by Anganwadi Workers who have been trained in identifying SAM are needed in order to inform policy on case detection by Anganwadi Workers.

3.15 The Integrated Child Development Services (ICDS) scheme

The Integrated Child Development Services Scheme (here after ICDS) is the flagship programme of the Government of India responding to the burden of childhood malnutrition in India. At the centre, it is under the Ministry of Women and Child Development but is administered as separate State Government agencies. It was established in 1975 with the following objectives(32):

1. to improve the nutritional and health status of children in the age-group 0-6 years;
2. to lay the foundation for proper psychological, physical and social development of the child;
3. to reduce the incidence of mortality, morbidity, malnutrition and school dropout;
4. to achieve effective co-ordination of policy and implementation amongst the various departments to promote child development; and
5. to enhance the capability of the mother to look after the normal health and nutritional needs of the child through proper nutrition and health education

It aims to achieve these objectives by providing an integrated package of the following services (32):

1. supplementary nutrition and growth monitoring
2. immunization
3. health check-up
4. referral services
5. pre-school non-formal education
6. nutrition & health education.

Immunisation, health check up and referral services are delivered through linkages with the public health services of the Ministry Of Health and Family Welfare.

The services are provided through day care centres known as an Anganwadi Centres (AWC) or 'Anganwadis'(also known as a 'Balwadis' in Tamil Nadu) which are by operated health workers known as Anganwadi Workers (hereafter AWW). The beneficiaries are children aged 0 to 6 years and pregnant women and lactating mothers. The Tamil Nadu ICDS also provides nutrition to old age pensioners, destitute persons, the disabled and widows(38) . Nutrition in Anganwadis is provided free of cost to the beneficiaries throughout India. In Tamil Nadu community participation is solicited for the running of the Anganwadi through measures like replacing firewood with cooking gas, setting up vegetable gardens and providing additional toys for the children(38)

3.15.1 Growth monitoring in ICDS

Growth monitoring is done by the Anganwadi Workers for each child attending an Anganwadi Centre. Each child below the age of 3 years is weighed once a month and children between 3 to 6 years of age are weighed every 3 months. The weight is plotted on a

weight for age Growth chart and the curve obtained is interpreted by the Anganwadi Worker to identify children whose growth is faltering so that they can be referred to the nearest health facility. The Growth Chart is part of a Card which is kept for all children enrolled in the Anganwadi. Since 2008 the Ministry of Women and Child Development adopted the WHO Child Growth Standards as its reference population for classifying the nutrition status of children in ICDS(39).

3.15.2 Population served by ICDS

The ICDS is the largest programme in the world addressing early childhood development(8,9,19) It operates through a network of over 1.3 million Anganwadi Centres(AWCs)(40). The following table summarises statistics of the ICDS published in March 2012 (40).

Table 3.5 Number of Anganwadi Centres and Children served by ICDS in India and Tamil Nadu March 2012

	India	Tamil Nadu
Number of Anganwadi Centres Sanctioned	1,370,718	55,020
Number of Angwadi Centres Operational	1,304,611	54,439
Number of children receiving supplementary nutrition (aged 6 months to 6 years)	79,005,328	2,726,805
Number of children given preschool education (age3-6 years)	35,821,706	1,123,974

3.15.2.1 Population Norms

The Anganwadi Centres are administratively grouped into ICDS Projects. Each ICDS Project serves the population of each Community Development block in rural areas and 100,000

population in urban areas. In rural and urban areas an Anganwadi Centre is to be provided for every 800 residents of the project area and in hilly/remote areas one centre for every 300 – 800 population(39).

3.15.3 ICDS coverage and utilization

The extent of coverage and utilization of ICDS was surveyed in NFHS3 (2005 – 2006). The following table shows the coverage of Anganwadi Centres (AWC) in the enumeration areas surveyed in NFHS3 in India on the whole and Tamil Nadu(8):

Table 3.6 Coverage and Utilization of ICDS in India and Tamil Nadu NFHS3

	India	Tamil Nadu
Percentage of enumeration areas covered by an AWC that has been established for at least five years	62.1%	91.2%
Percentage of enumeration areas covered by an AWC	72.4%	96.3%
Number of enumeration areas	3850	214
Percentage of children under age six living in enumeration areas covered by an AWC	81.1%	97.0%
Percentage of children under age six who received any service from an AWC in the past year	28.4%	41.6%

Overall across India 81.1% of children live in an area with an AWC, and in Tamil Nadu the coverage is higher with 97% of children below 6 years of age having access to an AWC. Utilization of ICDS seems to be quite poor on average across the country at 28.4%, with Tamil Nadu better at 41.6%. The relatively low utilization compared to high coverage in

Tamil Nadu may be a reflection of the smaller proportion of the children who require the services from the ICDS compared to those who do not.

The HUNGaMa survey also examined the coverage and utilization of Anganwadi Centres among the districts surveyed. The availability of Angwadi Centres in the villages surveyed is shown below (19).

Table 3.7 Availability of Anganwadi Centres in villages HUNGaMa survey 2011

	100 focus districts	6 best districts from focus states	6 best districts of best states
Availability of Anganwadi centre in the village	96%	98.6%	100%

The table shows that according to the HUNGaMa study, the availability of Anganwadi centres even in the worst districts (with respect to child development) is quite high.

3.15.4 ICDS staffing structure (32)

In most states including Tamil Nadu he ICDS is staffed by Anganwadi Workers (AWW) who are the grass root community level workers. Each Anganwadi worker is responsible for the functioning of an Anganwadi Centre. The AWW is assisted by an Anganwadi Helper (AWH). Middle level supervision is provided by a cadre of Supervisors. Supervisors report to the designated Child Development Project Officer in charge of each ICDS Project. All the project areas in a district come under the responsibility of the District Programme Officer.

3.15.5 Anganwadi Workers

The Anganwadi Worker (AWW) is the community level health worker of the ICDS through whom the services of the ICDS are provided to the community.

3.15.5.1 Eligibility

Eligibility criteria for appointment of Tamil Nadu ICDS Anganwadi Workers is(9):

1. Local residence within 3 km

2. Age 25 to 35, but this may be relaxed to 40 years for widows, single women deserted by their husbands and applicants from remote hilly areas

3. Education: std 10 pass

3.15.5.2 Selection

Selection in Tamil Nadu is by a committee consisting of the ICDS District Programme Officer, Medical officer, Block Development Officer (not applicable to Chennai), Child Development Project Officer. The appointment authority for all AWWs is the District Collector except in Chennai where the Commissioner of ICDS is the appointing authority (9).

3.15.5.3 Roles and responsibilities of Anganwadi Workers

The roles were last finalized in 2006 by a joint statement of the secretaries of Ministry for Women and Child Development and Ministry of Health and Family Welfare(41) and include the following:

1. To bring about community participation in the running of the programme.

2. Growth Monitoring:

    a. weighing each child monthly or quarterly according to the age

    b. recording the weight on a weight for age growth chart

    c. maintain child cards for all children below 6 years age

    d. referring children when necessary according to nutritional status or medical illness

3. Survey: to conduct a survey of the facilities, women and children in the surrounding community once a year.

4. Supplementary nutrition: to plan and provide supplementary feeding for children aged 6 months to 6 years and pregnant or lactating mothers from locally available foods and recipes.

5. Health and Nutrition Education: to provide education for

    a. mothers on nutrition, child health, breast feeding and healthy complementary feeding.

    b. To provide health education for adolescent girls and their parents.

6. Home visits: to carry out home visits to impart education to parents and to identify disabled children for referral

7. Preschool activities – to carry out preschool activities for children aged 3 to 6 years towards non formal preschool education

8. Maintain registers for various activities

9. Submit reports of activities

10. Inform the supervisors or CDPO of any issues in the community which could affect the programme and its coordination with other government departments

11. Coordinate with other programmes:

    a. With ANMs/VHNs - share information and inform them of children with acute illnesses, Stock Iron Folic Acid and Vitamin A and assist the ANM/VHN in administration of the same.

    b. With ASHAs – guide ASHAs and share information

c. With lady school teachers - in assisting in preschool and adolescent girl education

d. To aid in pulse polio immunization drives

As can be seen, growth monitoring is one among many roles that an Anganwadi Worker has to fulfill.

3.15.5.4 Training of Anganwadi Workers

Training is crucial to the effective functioning of the ICDS because it is heavily dependent on the staff at all levels to provide services to the community. There are three types of training in ICDS that Anganwadi Workers undergo(42)

Induction Training: Training that is given on initial appointment

Job/Orientation Training: training that is given once during service

Refresher training given once every 2 years.

In addition, each State/Union Territory is at liberty to add training programmes according to their needs under a separate component called 'Other Training'. According to the Programme Content of the training of Anganwadi workers, Induction training consists of a 30 day course in which 2 hours are set aside for training in growth monitoring(43).

3.15.6 Tamil Nadu ICDS

The ICDS has had a good track record in Tamil Nadu and through political support and public expectations has developed to provide better quality services than the ICDS of other states(38). In terms of working hours, enrollment, infrastructure and payment of workers, the Tamil Nadu ICDS is said to be better than many other states (38). Tamil Nadu ICDS compares favourably against the All India averages of ICDS in terms of proportion of children with normal nutritional status (70.12% compared to 62.68%, measured as weight for

age) and proportion of children with severe malnutrition (0.50% compared to 3.21%, measured as weight for age)(40).

4 MATERIALS AND METHODS

4.1 Study Setting

The study was conducted in the Vellore ICDS Urban Project Area. Vellore City forms a part of the Vellore Metropolitan Region which is the capital of Vellore District, Tamil Nadu. The urban population of Vellore is 481,966 with 45,049 children aged 0 - 6(44) At the time of the study, the Vellore ICDS Urban Project consisted of 100 Anganwadi Centres (AWCs) in which approximately 1500 children were enrolled. There were sixty seven Anganwadi Workers, four Supervisors and one Child Development Project Officer in charge of the Project. The Project is a part of the Vellore District ICDS Programme which is administered by the Vellore District ICDS Programme Officer. The study was done with the permission and support of the Vellore ICDS District Programme Officer. Permission was sought from the Principal Secretary/Special Commissioner of Tamil Nadu ICDS to publish data obtained from the study in this dissertation. Please see Annexure 3.

The study had two parts: a training course and a survey. Methodology for each is described separately below.

4.2 Instruments

The following instruments were used for the training course and the survey:

4.2.1 Weighing scale:

Essae® Electronic Weighing scale Class III Model Number PS-250 Machine number PS 25005109, maximum weight 150 kg, precision 100g as per WHO guidelines(45). The scale was calibrated by the manufacturer. Please see Annexure 4

4.2.2 MUAC measuring tape:

TALC Small Coloured Insertion Tape (MUAC) Original Grid View Style 115mm. The tape has coloured coded cutoffs for severe acute malnutrition at 115mm and moderate acute malnutrition at 125 mm with grid view of measurements(46). Precision 2mm. Purchased from Teaching Aids at Low Cost, UK. Please see Annexure 5.

4.2.3 Infantometer/Height Board

A height board was custom- made locally according to WHO guidelines(45) with the exception that a 1.2 metre steel carpenter's scale with 0.1cm precision was used instead of the recommended plastic measuring tape because the orientation of the numbers on all locally available measuring tapes were inappropriate for checking height. Please see Annexure 6.

4.3 Growth Charts

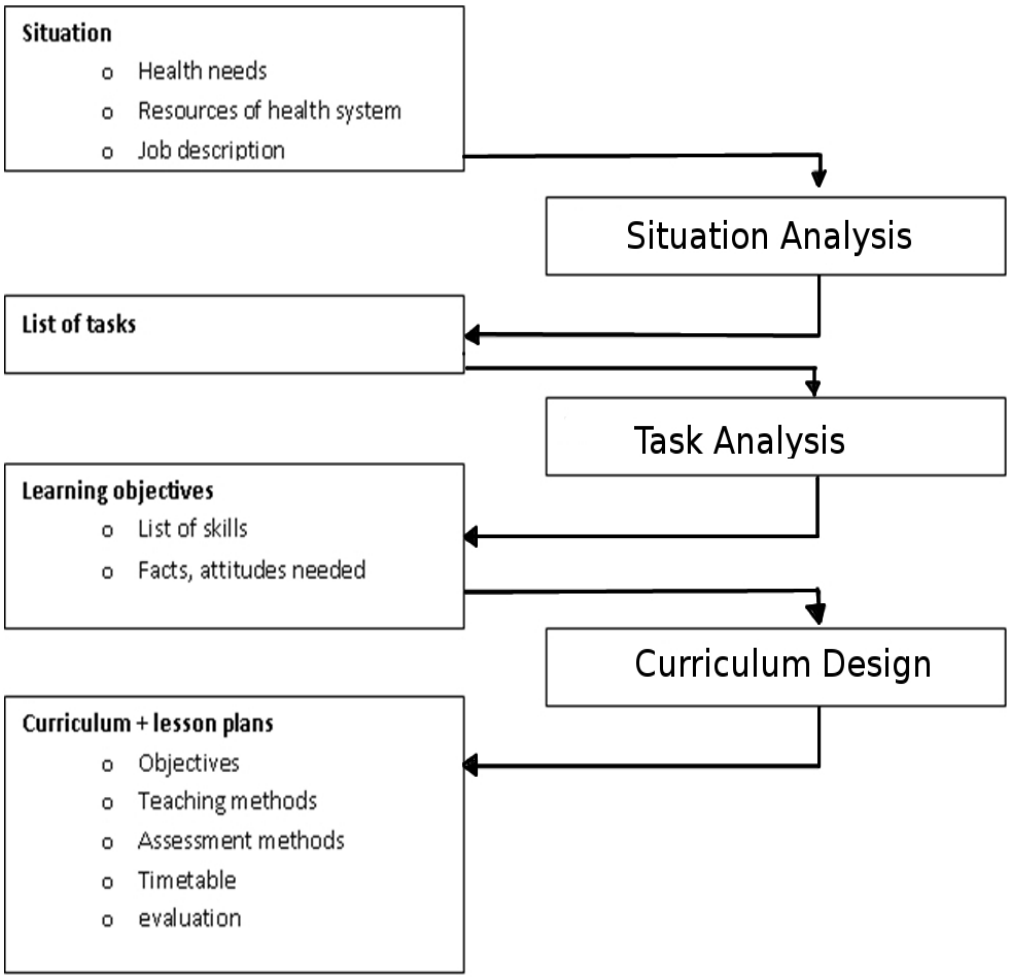
The WHO Weight-for-Height Z score charts for boys and girls aged 2 to 5 years were used. These charts are based on the 2006 WHO Child Growth Standards. Please see Annexure 7.

4.4 Methodology of Training Course

4.4.1 Designing the training course

The methodology used for designing the training course was taken from the WHO manual for training primary health care staff by F.R. Abbatt(47) The frame work for this methodology is summarized in the diagram below:

Figure 4 Methodology of Curriculum Design (adapted from 'Teaching for Better Learning' by Abbatt (45)



4.4.1.1 Situation analysis

The situation analysis is a description of the needs of the health system and a description of the work the health workers are expected to do(45). The objective of the course was to train AWWs to identify children with SAM. The Vellore ICDS Urban Project like most other ICDS Projects carries out growth monitoring by measuring weight for age at regular intervals using the hanging Salter Scales. Thus there was no need for training in determining a child's age. Some of the Anganwadi workers had heard of measuring MUAC as a measure of malnutrition but they did not have training in using MUAC insertion tapes, measuring height, checking pedal edema or using electronic weighing scales. They did not have training in

finding Z-scores from growth charts but they were familiar in plotting a weight for age chart. On discussion with the ICDS personnel the investigator was told that the Anganwadis of the Vellore urban project predominantly serve children from the age of 2 years or more and all children were enrolled after becoming ambulant. Keeping in mind the objective of the course and the skills of Anganwadi workers a list of tasks was made for identifying SAM among children in the Anganwadis

4.4.1.2 List of tasks

The following list of tasks was decided upon according to the situation and objectives of the course:

1. Examine children for bilateral pedal edema and record finding
2. Measure and record weight
3. Measure and record height
4. Measure and record MUAC
5. Determine and record weight for height Z-score
6. Determine whether child has SAM and refer children with SAM

It was decided that training to check length for children who were too young to stand upright was not required in the study setting.

4.4.1.3 Task analysis

After setting down the tasks needed to be carried out, literature was searched on the proper techniques used for the tasks. For measuring weight and height and examining children for pedal edema the WHO Child Growth Reference Study training manual(43), a video published

by the WHO Child Growth Reference Study on anthropometry(46) and MOHFW guidelines for facility based management of SAM(28) were used. For measuring MUAC the MOHFW guidelines for facility based management of SAM, the MSF Nutrition Guidelines 1995(47,48), were used. Weight for Height growth charts for determining Z-score were downloaded from the WHO website (49).

After reviewing the literature, a list of subtasks (or steps) for each task was made and the necessary knowledge and attitudes were decided upon and written down in a tabular form to form task analysis tables. Please refer to Annexure 8 for the task analysis tables.

4.4.1.4 Learning objectives

From the task analysis tables a list of learning objectives was decided upon. These were classified as

- performance objectives – procedures which the AWWs should learn to perform
- enabling objectives – knowledge and attitudes that would enable to the AWWs to perform the procedures.

4.4.1.5 Curriculum design

Using the task analysis and learning objectives the curriculum was designed. The curriculum contained the following information:

1. The course objectives
2. The methods that would be used to teach the AWWs
3. The timetable for the training course
4. The methods used to evaluate the AWWs.

Please see Annexure 9 for the Course Curriculum.

4.4.1.6 Lesson plan

Using the curriculum, list of objectives and task analysis a lesson plan for each session was made. The lesson plan stated for each session:

1. Objectives
2. key points to be taught
3. activities to be carried out
4. method of assessment

Please see Annexure 10 for the Lesson Plan

4.4.1.7 Training material

Using the literature cited above and according to the objectives and activities stated in the curriculum, a training manual for the Anganwadi Workers in the identification of Severe Acute Malnutrition among children aged 2 to 5 years was written and designed by the Investigator in English (please see Annexure 11). After proof reading, the manual was translated into Tamil. A copy of the Tamil Manual was back translated (verbally) into English. The manual was then piloted on field workers of the Community Health Department of CMC Vellore to check for clarity and ease of understanding.

4.4.1.8 Assessment

Theory Assessment

The AWWs underwent theory test consisting of objective multiple choice questions before (pretest) and after (post test) the training sessions of the course. The question paper was written by the investigator. Then it was translated and typed in Tamil. It was then back translated verbally into English. Please see Annexure 12.

Practical Assessment

The AWWs underwent a practical test consisting of an Observed Structured Practical Examination before (pretest) and after (post test) the training sessions of the course. The exam consisted of measurement and oral reporting of the weight, height, mid upper arm circumference and examination for pedal oedema of children enrolled in an Anganwadi near the training site. Marks were given for demonstrating the various steps required to make the measurements and examination for pedal oedema according to a checklist made by the investigator (please see Annexure 13.

A written assessment consisting of written exercises on assigning Z-scores according to given measurements was done after the training sessions.

4.4.2 Implementation of training course

4.4.2.1 Pilot training session

The manual and training session were initially piloted on 7 ANMs (Health Aides of the Community Health Department) on 14/5/12 at the Community Health Training Centre in CMC Vellore Bagayam campus. The session was conducted by the investigator and lasted 2 hours. Demonstration of anthropometry was done at the Paediatric Ward of the Community Health And Development Hospital. The manual was found to be clear and the lectures and demonstrations understandable. It was recommended by one of the ANMs that the weight for height charts should be projected onto a screen to demonstrate how Z-scores are assigned using the weight-for-height charts. This suggestion was incorporated into the teaching methodology.

4.4.2.2 Consent

Prior to conducting the training written informed consent was obtained from all the AWWs participating in the study.

4.4.2.3 Data collection

At the time of the Theory pretest evaluation, data on each Anganwadi Worker was collected for the following variables:

1. Age
2. Anganwadi Centre Number
3. Education
4. Number of Years in ICDS

The theory marks and practical marks for the evaluation were used as data to evaluate the training course.

4.4.2.4 Training

Setting: All the training sessions including the evaluation sessions were held at the Municipal Urban Health Centre in the Kaspa locality of Vellore City with permission of the Medical Officer of the Centre. The venue was within the Project Area. For demonstrations, practice sessions and practical assessments children aged 2 to 5 from two nearby AWCs were used as subjects with verbal permission from parents.

Participants: Initially 62 Anganwadi Workers of the ICDS Project enrolled in the course. 57 of the workers completed the course. The workers were divided into batches of approximately 20 for the OSPE, training sessions and practice sessions.

Materials:

1. Manual on Identifying SAM in children aged 2-5 years was given to each AWW. Please see the Annexure 11.

2. Instruments: Digital weighing scale, infantometer (heightboard) and MUAC insertion tape. These are described above. Please see Appendices 4 to 6 for pictures.

3. Laptop Computer and LCD Projector for projecting videos of anthropometry and displaying weight for height charts.

Schedule of Implementation

The training course was conducted as per the following dates:

Table 4.1 Schedule of Implementation of Training

Session	**Batch**	**Date**
Consent and Pretest Theory Evaluation	All Batches	15/5/12
Observed Structural Practical Exam pretest and Training Sessions	Batch 1 Batch 2 Batch 3	15/5/12 17/5/12 18/5/12
Practice Sessions	Batch 1 Batch 2 Batch 3	21/5/12 22/5/12 24/5/12
Post Test Theory Evaluation and Z-score written exercise	All Batches	31/5/12
Post Test Observed Structured Practical Exam	Batch 1 Batch 2 Batch 3	31/5/12 4/6/12 7/6/12

Training Sessions

All sessions were carried out in the afternoon starting at 2:30 pm. The lesson plan of the course was carried out during a single training session which lasted on average 2.5 hours.

Practice Sessions

A supervised practice session was held for each batch, lasting 2.5 hours. Each of the Anganwadi workers practiced taking measurements on children from nearby Anganwadis and then demonstrated the same to the investigator.

4.4.2.5 Source of bias

There was potential for reporting bias by the investigator in assigning marks during the OSPE. The evaluation would have been more objective if the AWWs were evaluated by a suitably qualified person who was not directly involved in the training. This could not be arranged.

4.4.2.6 Data management

After the training course the demographic data, marks from theory evaluations, marks from the OSPEs and the written exercise on Z-scores were entered into a database using Epidata v 3.1 software and analysed using SPSS version 12.0 software.

4.5 Methodology of Survey

4.5.1 Objectives

The objectives of the survey were to validate the anthropometry and classification of malnutrition done by the AWWs and to determine the prevalence of SAM in the Vellore ICDS Urban Project area using measurements and classification by the Anganwadi workers.

4.5.2 Setting

The survey was conducted as part of a series of health camps carried out at Anganwadi centres in the Vellore ICDS Urban Project area between 20/6/12 and 10/8/12. The health camps were a joint project of the Vellore ICDS and the Community Health Department of CMC Vellore. The project was inaugurated by the District Collector Shri Ajay Yadav, IAS, on 12/4/12. Each child present at the camp underwent anthropometry by the AWWs and a medical checkup conducted by the investigator. Medicines for the children were prescribed according to their diagnosis. If further management was required, children were referred to the Low Cost Effective Care Unit of the Community Health Department of CMC Vellore. The unit is located within the ICDS Project Area. A Child Health Card was issued to each child for recording of anthropometric measurements and diagnosis along with clinical findings, diagnosis and treatment. These records were submitted to the ICDS Project Office after each camp. The Child Health Card was designed by the investigator and supplied by the Vellore ICDS. Please see Annexure 16. Anthropometric data was also entered into proformas which were kept by the investigator (please see Annexure 14). Children found to have wasting during the camps were referred to the Low Cost Effective Care Unit and all children found to have SAM at the end of data analysis were referred to CHAD hospital of the Community Health Department.

4.5.3 Inclusion criteria

Children aged 2 to 5 years enrolled in the Anganwadi Centre.

4.5.4 Sample size

FOR PREVALENCE OF SAM

The required sample was 1112 taken from the formula

$n=4pq/d^2$ where p=0.09*, q=0.91 and d=0.2x0.09

*taken from NFHS III survey: 8.9 % children aged less than 5 in Tamil Nadu have weight for height Z-score less than -3

There were approximately 1500 children in the Vellore urban ICDS project area Aganwadis, assuming 20% absentee children, the required sample size would be met with the above sample size. All the children in the Anganwadi were measured by the Anganwadi Worker. The total number of children surveyed was 744.

FOR VALIDATION

7 out of all the children measured by each Anganwadi Worker were measured by the investigator. The number of children from each anganwadi varied greatly between 7 and 30 and so it was decided that a minimum of 7 children or all the children from that AWC available would be validated (depending on which was more) in order to provide an adequate proportion of validations even if there were few or many children present at each Anganwadi Centre.

4.5.5 Sample Selection

The children taken for validation were randomly selected by lots after the Anganwadi worker had finished taking most (if not all) her measurements.

4.5.6 Source of Data

4.5.6.1 Demographic data of anganwadi children

All demographic data was reported by the Anganwadi workers from Anganwadi records.

1. Age of children – calculated in months using date of births entered in Anganwadi records
2. Gender
3. Father's name

4. Father's occupation and education
5. Mother's occupation and education
6. Number and elder and younger siblings and gender

Please see the proforma used in Annexure 15.

4.5.6.2 Anthropometric data of anganwadi children

Anthropometric data was collected by AWW and investigator using instruments and reference charts described earlier in this section.

1. Weight - measured to nearest 0.1 kg
2. Height – measured to nearest 0.1 cm
3. MUAC – measured to 2 mm precision
4. Presence/absence of bilateral pedal oedema
5. WHZ category– as read from WHO weight-for-height growth charts.
6. SAM present or absent

Please see the proforma in Annexure 14.

On analyzing the results from the Z-score categorization assessment it was noted that very few of the AWWs were able to assign and record a WHZ greater than -3 correctly. Because of time constraints a separate retraining session was not organized. Instead the method used for assigning and recording Z-scores was demonstrated to each AWW once before the scores were assigned to each child during the camps. Also, during each camp the technique used for measuring MUAC was rechecked once for all workers and the correct technique was demonstrated when necessary.

4.5.7 Sources of bias and measures taken to reduce bias

1. **Reporting bias** by the investigator and anganwadi workers. It was reduced by:
    a. Random selection of children for validation after measurements by Anganwadi workers were made – ensuring masking of children selected for validation from Anganwadi workers.
    b. Masking the investigator from the measurements obtained by the anganwadi workers until validation measurements were recorded.
2. **Selection bias** – only children coming to the AWC on the day of check up were included. Children absent due to illness were missed if they were too sick or were taken to a hospital.

4.5.8 Data management

ANTHROPOMETRIC DATA

Anthropometric data was entered into a database using the WHO ANTHRO v3.2.2 computer programme(51) designed for anthropometric surveys and calculations. Using ANTHRO the exact WHZ, HAZ, WAZ and MUAC for Age Z-score were generated for each child measured by the AWWs and the investigator. After data entry and data processing in ANTHRO the database generated was exported to SPSS v12 for statistical analysis. Data entry was then checked for errors by the investigator and co investigator.

DEMOGRAPHIC DATA

Demographic data was entered into Epidata v 3.1 data entry software. The resulting database was exported to SPSS v12 and merged with the anthropometry database to generate a composite database of all the demographic data, measurements and Z-scores for each child in the survey. Any double entries in demographic data were found at the time of merging the databases.

5 RESULTS

5.1 Results of Training Assessment

5.1.1 Demography

There were 62 Anganwadi Workers (AWWs) enrolled in the Vellore ICDS Urban project at the time of training. 57 AWWs completed the training course. Their demographic features are given below:

Table 5.1 Demography of AWWs trained

	age	Number of years in ICDS
Mean	52.51	25.63
Median	54.00	29.00
Range	31	28
Minimum	28	3
Maximum	59	31

The table shows that the AWWs were on average more than 50 years old and had 25 years of service in ICDS.

Table 5.2 Age categories of AWWs trained

Age group	Frequency	Percent	Cumulative Percent
55 – 59	23	40.4	40.4
50 – 54	26	45.6	86.0
45 – 49	3	5.3	91.2
35 – 39	2	3.5	94.7
30 – 34	2	3.5	98.2
25 – 29	1	1.8	100.0
Total	57	100.0	

The table shows that 86 % of the workers were above the age of 50.

Thus the workers comprised a largely middle aged group of women who have been working in the ICDS for more than 20 years on average.

5.1.2 Qualification

Table 5.3 Qualification of AWWs trained

	Frequency	Percent	Cumulative Percent
std 10	39	68.4	68.4
std 12	7	12.3	80.7
graduate	2	3.5	84.2
post graduate	9	15.8	100.0
Total	57	100.0	

The majority of workers had qualified as standard 10 pass but 9 of them had received a post graduate degree.

5.1.3 Refractive Errors

Table 5.4 Frequency of Refractive Errors among the Anganwadi Workers

	Frequency	Valid Percent
no refractive error	11	19.3
refractive error	46	80.7
Total	57	100.0

80.7 % of the AWWs had refractive errors.

5.1.4 Theory Assessment

Statistics of Knowledge test scores

Table 5.5 Statistics of Knowledge Pretest and Post test

	Knowledge Scores	
	Pre test (out of 15 marks)	Post test (out of 15 marks)
Mean	9.5263	12.8772
Std. Error of Mean	.19406	.19879
Median	9.0000	13.0000
Minimum	6.00	7.00
Maximum	13.00	15.00

The mean pretest and post test knowledge scores were 9.5/15 and 12.9/15 respectively. The minimum scores were 7 and 8 respectively.

Paired T-test for significance of difference between Post test and Pretest Knowledge scores

Table 5.6 Statistics of Difference in Knowledge Pretest and Post test means

Paired Differences					t	Degrees of freedom	Significance
Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
3.35088	1.60903	.21312	2.92394	3.77781	15.723	56	<0.01

The mean difference between the pretest and post test knowledge scores was 3.35/15 and it was statistically significant ($p<0.01$) according to the Paired T-test.

5.1.5 Practical assessment

Statistics of Practical Test scores

Table 5.7 Statistics of Practical Pretest and Post test

	Practical Scores	
	Pre test (out of 24 marks)	Post test (out of 24 marks)
Mean	6.2203	18.3559
Std. Error of Mean	.20092	.36645
Median	6.0000	19.0000
Minimum	4.00	9.00
Maximum	12.00	23.00

The mean pretest and post test practical scores were 6.2/24 and 18.3/24 respectively. This is a bigger difference than that of the knowledge scores.

Paired T test for significance of difference between Post test and Pre Test practical scores

Table 5.8 Statistics of Difference in Practical Pretest and Posttest means

Paired Differences					t	Degrees of freedom	Significance
Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
12.17544	3.12320	.41368	11.34674	13.00414	29.432	56	<0.01

The mean difference between the pretest and post test knowledge scores was 12.2/24 which was statistically significant ($p<0.01$) according to the Paired T-test.

Distribution of Marks in Practical Post test

Table 5.9 Distribution of Marks in Practical Posttest

Total Post test Practical marks	Number of AWWs	Percent	Cumulative Percent
23	2	3.5	3.5
22	3	5.3	8.8
21	8	14.0	22.8
20	9	15.8	38.6
19	11	19.3	57.9
less than or equal to 18	24	42.1	100
Total	57	100.0	

The table shows that 58 per cent of the workers got more than 18 out of 24 marks in the practical marks which correspond to knowing all the essential steps required to make measurements correctly.

5.1.6 WHZ-score categorization assessment

Two AWWs did not attend this assessment, so the marks are given for the remaining 55. The mean score was 2.13 out of 4 marks. Each mark was given for a classification which was recorded correctly.

The distribution of marks is given below:

Table 5.10 Distribution of total marks in WHZ categorization assessment

Total marks	Frequency	Percent	Cumulative Percent
0	16	28.1	29.6
1	2	3.5	33.3
2	2	3.5	37.0
3	27	47.4	87.0
4	7	12.3	100.0
Missing	3	5.3	
Total	57	100.0	

The Distribution of incorrect and correct answers for each question is given below:

5.11 Distribution of incorrect and correct answers in WHZ categorization assessment

	Number of AWWs who categorized incorrectly	Number of AWWs who categorized correctly
Q1 (WHZ <-3)	18 (33%)	37 (67%)
Q2 WHZ -2 TO -3)	44 (80%)	11 (20%)
Q3 (WHZ <-3)	20 (36%)	35 (64%)
Q4 (WHZ <-3)	19 (35%)	36 (65%)

80% of the workers could not categorize a WHZ -2 to -3 correctly and on average only 65% were able to categorize a WHZ <-3 correctly.

5.2 Results of Prevalence Survey

5.2.1 Demography of Children surveyed

The total number of children surveyed was 747

Total no. of Anganwadis in which children surveyed were enrolled was 57

5.2.1.1 Age of Children surveyed

The age characteristics of the children surveyed are given below:

Table 5.12 Statistics of Age of children surveyed

	Age in months
Mean	38.2
Median	36.6
Std. Deviation	8.8
Range	36.1
Minimum	24.1
Maximum	60.1

The mean age of children was 38 months and median was 36 months, so the children tended to be around 3 years old.

5.2.1.2 Sex of children surveyed

Table 5.13 Sex distribution of children surveyed

	Frequency	Percent
Female	387	51.8
Male	360	48.2
Total	747	100.0

The proportion of females and males were almost equal with a slightly larger proportion of female children in the survey.

5.2.1.3 Fathers' Occupation

The occupations of the fathers of the children surveyed are given below:

Table 5.14 Fathers' occupation of children surveyed

	Frequency	Percentage
Autodriver	104	13.9
Beedi work	59	7.9
Shop work	87	11.6
Hawker/Street vendor	50	6.7
Load worker	40	5.4
Construction work	33	4.4
Other unskilled manual labour	144	19.3
Skilled labour	41	5.5
Lorry driver	23	3.1
Business	20	2.7
White collar (clerk/salesman/peon)	30	4.0
CMC attender/sweeper	13	1.7
Electrician/Mechanic/Technician	24	3.2
Expired	8	1.1
Others	31	4.1
Unemployed	8	1.1
Unknown	32	4.3
Total	747	100

55.3% of the fathers had an occupation involving unskilled manual labour and were receiving daily wages. Together with autodrivers they form 69.2% of the fathers. There were no professionals.

5.2.1.4 Mother's occupation

The occupations of the mothers of the children surveyed are given below:

Table 5.15 Mothers' occupation of children surveyed

	Frequency	Percentage
House wife	647	86.7
Beediwork	29	3.9
Manual labour	22	2.9
Constructionwork	11	1.5
Housemaid	11	1.5
Shopwork	4	0.6
Business	2	0.3
Others	10	1.3
Unknown	11	1.5
Total	747	100

Most of the mothers were housewives. Among those who had jobs, the majority were involved with unskilled manual labour. There were no professionals among the mothers or the fathers of the children surveyed.

5.2.1.5 Parents Education:

The education of the parents is given below:

Table 5.16 Education of Parents of children surveyed

	Fathers' Education		Mothers' Education	
	Frequency	Cumulative Percent	Frequency	Cumulative Percent
0 - 5 years	239	32.5	310	42.1
6 - 9 years	304	73.8	239	74.6
10 years	127	91.0	118	90.6
11 - 12 ears	31	95.2	43	96.5
13 + years	35	100.0	26	100.0
unknown	11		11	
Total	747		747	

The data shows that most of the parents were educated to less than 10 years with 32.5% of the fathers and 42.1 percent of the mothers having 5or less years of education.

5.2.2 Demography of absent children.

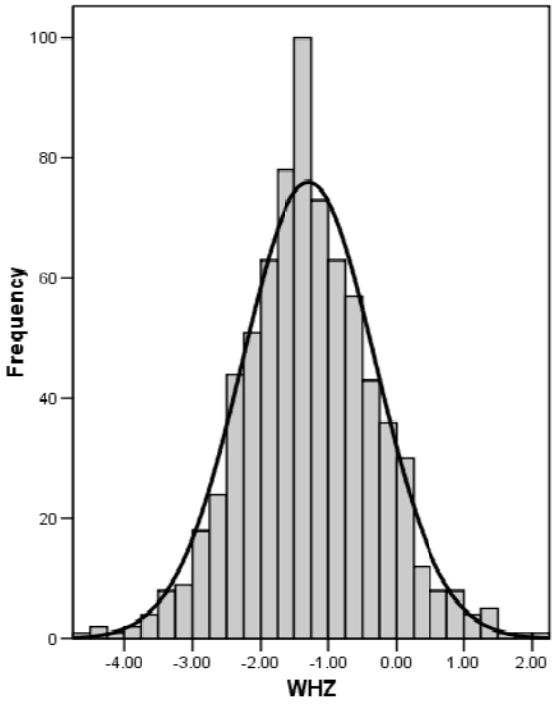
There were 145 children absent during the survey. The total percentage of children enrolled in the ICDS Project who were absent for the survey was 16%.

5.2.3 Prevalence of Malnutrition

The prevalence of malnutrition was determined using the AWW measurements and Z-scores classification was computer generated by the computer programme 'WHO Anthro'.

5.2.3.1 Prevalence of Wasting and SAM

The weight for height z score was normally distributed as shown below:



Statistics of Weight for Height Z score:

Table 5.17 Statistics of WHZ of children surveyed

Mean	-1.2918
Median	-1.3300
Std. Deviation	.97960
Range	6.81
Minimum	-4.71
Maximum	2.10

The proportions of children in each WHZ category are shown below:

Table 5.18 Frequency Distribution of WHZ categories

WHZ	Frequency	Percent
-3.00 or less	27	3.6
-2.00 to -3.00	140	18.7
-1.00 to -2.00	312	41.8
0.00to -1.00	200	26.8
1.00 to 0.00	56	7.5
2.00 to 1.00	11	1.5
3.00 to 2.00	1	.1
Total	747	100.0

Prevalence of SAM = 3.7%; 95% CI 2.3% to 5.1% (this includes a child with MUAC <115 mm but WHZ >-3).

Prevalence of Moderate Acute Malnutrition (WHZ -2 to -3) = 18.7%; 95% CI 15.9% to 21.5%.

Prevalence of wasting (WHZ <-2) = 22.3%; 95% CI 19.3% to 25.3%.

5.2.3.2 Risk factors for SAM

Demographic characteristics that were significantly associated with presence of SAM were found to be mother's education and mother's occupation. The cross tabulation and Chi Square value are given below:

Table 5.19 Mother's Education and presence of SAM

Mother's Education	PRESENCE OF SAM		Total
	SAM	NO SAM	
Std 5 or less	17 5.5%	293 94.5%	310 100.0%
Greater than Std 5	10 2.3%	427 97.7%	437 100.0%
Total	27 3.6%	720 96.4%	747 100.0%

Chi Square = 5.316 (p = 0.021)

Table 5.20 Mother's Occupation and Presence of SAM

MOTHER'S OCCUPATION	PRESENCE OF SAM		Total
	SAM	NO SAM	
Working mother	8 9.0%	81 91.0%	89 100.0%
House wife or Unknown	19 2.9%	639 97.1%	658 100.0%
Total	27 3.7%	720 96.4%	747 100.0%

Chi Square = 8.109 (p = 0.004)

The data shows that low maternal education and a working mother were both significantly associated with SAM and so they have been identified as risk factors for SAM in the study population.

5.2.3.3 Prevalence of Stunting

The Height for Age Z-score was normally distributed as given below:

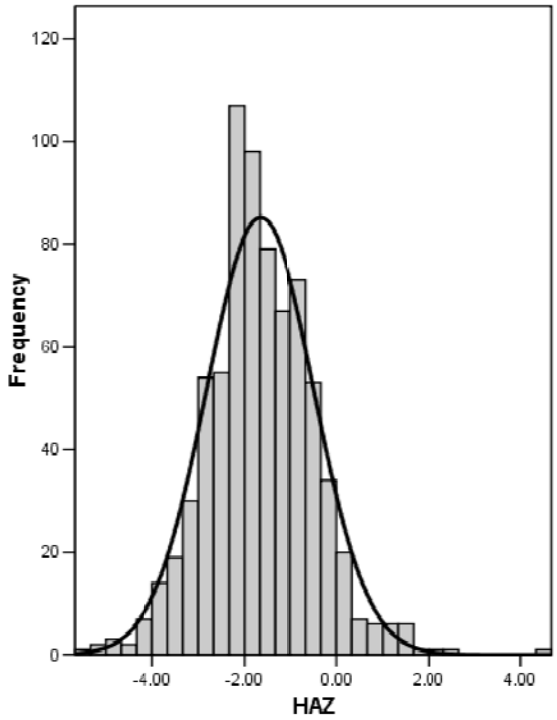


Table 5.21 Statistics of HAZ

Mean	-1.6558
Median	-1.7300
Std. Deviation	1.16492
Range	9.83
Minimum	-5.43
Maximum	4.40

Prevalence of Severe Stunting (HAZ <-3) = 10.4%; 95% CI 8.2% to 12.6%.

Prevalence of Stunting (HAZ <-2) = 39.3%; 95 % CI 35.8% to 42.8 %.

5.2.3.4 Prevalence of Underweight

The frequency distribution of WAZ was also normally distributed as shown below:

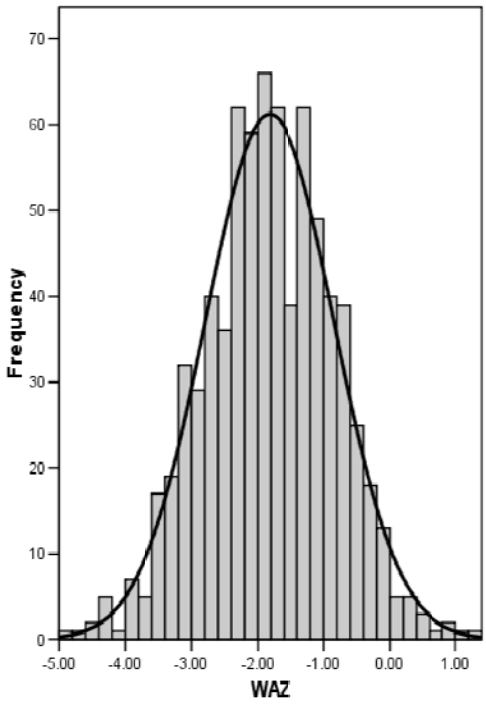


Table 5.22 Statistics of WAZ

Mean	-1.8199
Median	-1.8300
Std. Deviation	.97343
Range	6.05
Minimum	-4.82
Maximum	1.23

Prevalence of Severe Underweight (WAZ < -3) = 12.4 %; 95% CI 10.4% to 14.7%.

Prevalence of Underweight (WAZ <-2) =42.8 %; 95% CI 39.3% to 46.3%.

5.2.3.5 MUAC

The frequency distribution of MUAC is given below:

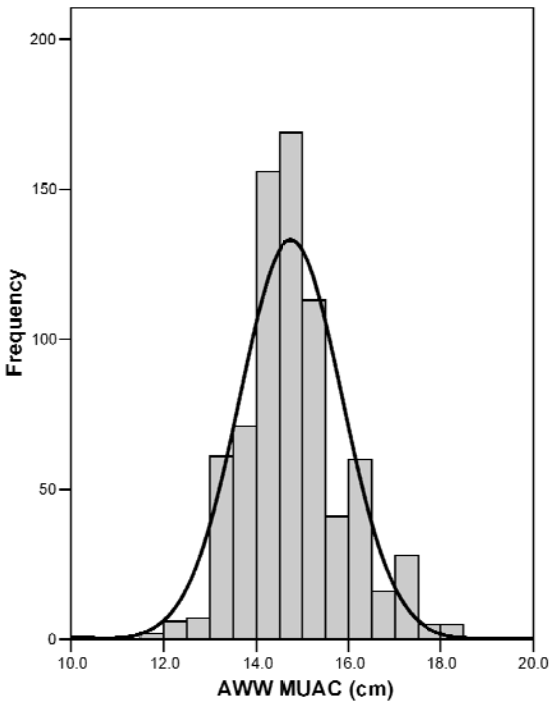


Table 5.23 Statistics of MUAC

Mean	14.750
Median	14.800
Std. Deviation	1.1094
Range	8.4
Minimum	10.0
Maximum	18.4

The mean MUAC was 14.8 cm which is above the measurement required for SAM and also more than 12.5 cm which has been used as a cut off for moderate wasting.

5.3 Results of Validation

5.3.1 Demography of validation sample

1. The total number of children in the validation sample was 289

2. The total no. of Anganwadi Centres from which the children were sampled was 46.

3. The total number of AWWs who were validated was 40.

5.3.1.1 Age of children in the validation sample (in months)

Table 5.24 Statistics of Age of children in Validation Sample

Mean	37.1
Median	35.2
Std. Deviation	8.4
Range	35.7
Minimum	24.2
Maximum	59.9

5.3.1.2 Sex Distribution of children in validation sample:

Table 5.25 Sex distribution of children in validation sample

		Frequency	Percent
Valid	Female	150	51.9
	Male	139	48.1
	Total	289	100.0

5.3.1.3 Number of children measured for each anthropometric parameter:

Table 5.26 Number of children measured in Validation sample

	Weight	Height	MUAC	Pedal edema
No. of children in validation sample	289	244	285	289

5.3.1.4 Number of workers validated for each anthropometric parameter:

Table 5.27 Number of workers validated in validation sample

	Weight	Height	MUAC	Pedal edema
No. of AWW validated	40	34	40	40

6 of the workers were unable to measure height due to osteoarthritis of their knees.

5.3.1.5 Percentage of children of each AWW selected into the validation sample

Table 5.28 Percentage of children's measurements validated

	Number of children Measured by AWWs	Percentage of children per AWW taken into the Validation Sample
Mean	18	47 %
Median	16	43%
Minimum	6	19%
Maximum	36	100%

The table shows that at least 19% of the workers measurements were validated and in some cases 100% of the measurements were validated. The percentage varied according to the varied number of children who were present from each Anganwadi centre during the survey.

5.3.2 Difference in Measurements

5.3.2.1 Frequency Distribution of Differences in Measurements (Validation measurements – AWW measurements)

Each child in the validation sample had two sets of measurements: measurements by the AWW and measurements by the principal investigator (hereon will be termed 'validation measurements'). The differences between the AWW measurements and validation measurements were first quantified as absolute differences (Validation measurement – AWW measurement). The following histograms show the frequency distribution absolute differences in height, weight and MUAC measurements between the AWW and Validation measurements.

Figure 5 Frequency distribution of Differences in Height Measurements

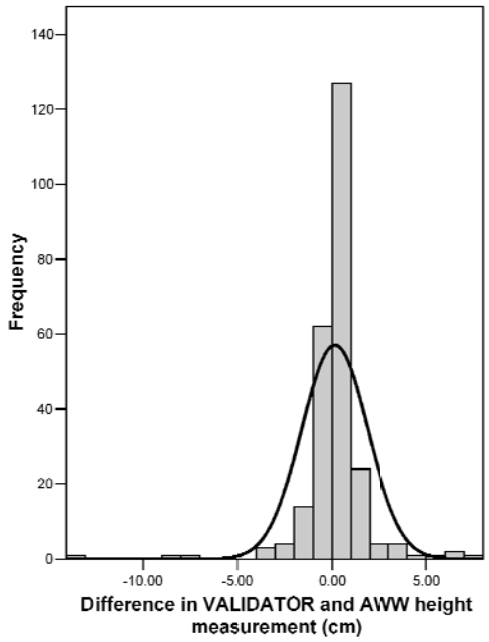


Figure 6 Frequency Distribution of Difference in Weight Measurements

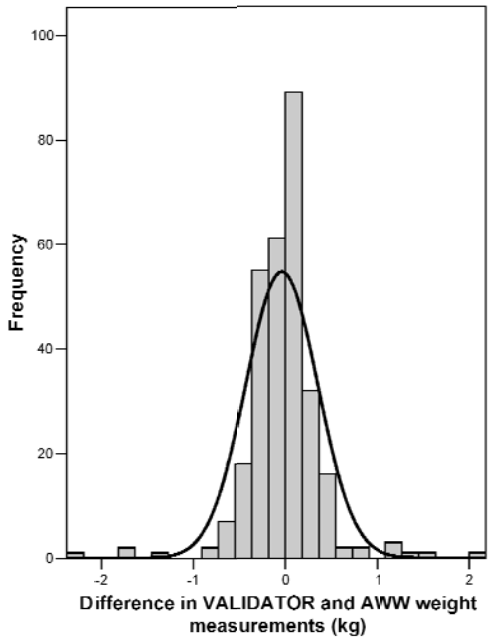
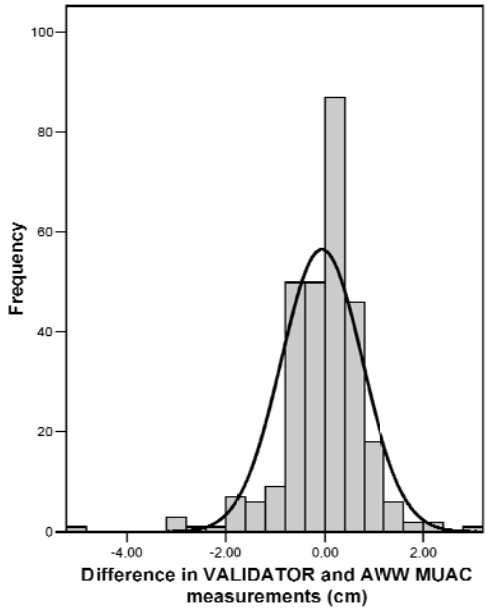


Figure 7 Frequency Distribution of Difference in MUAC measurements



The histograms show that the differences between the AWW and Validation measurements were all normally distributed.

5.3.2.2 Percentage Difference in Measurements between AWW and Validation measurements

The difference between the AWW measurements and Validation measurements were then analysed considering the magnitude of difference as a percentage of the validation measurements. The following statistics summarise the data on percentage difference between all AWW measurements and validation measurements:

Table 5.29 Statistics of Percentage Difference between Validation and AWW measurements

	Percent Difference in Height measurements	Percent Difference in Weight measurements	Percentage Difference in MUAC measurements
Mean	1.00%	2.14%	3.71%
Median	0.50%	1.11%	2.67%
Std. Deviation	1.74%	2.96%	4.48%
Range	16.27%	23.91%	40.62%
Minimum	0.00%	0.00%	0.00%
Maximum	16.27%	23.91%	40.62%

The data shows that the relative magnitude of difference was least in height measurements, more in weight measurements and most in MUAC measurements because the mean and median percentage differences show an increasing trend in that order. (Mean of percentage difference increased from height 1.00% to weight 2.14% to MUAC 3.71%). The variation in percentage difference was least in height, more in weight and most in MUAC measurements as is shown by the increasing size of the standard deviation and range of percentage difference in measurements.

The trend in increasing percentage difference from height to weight to MUAC measurements is further illustrated when we consider the distribution of measurements in various categories of percentage difference as given in the table below:

Table 5.30 Categories of Percentage Difference in Validation and AWW measurements

Percentage Difference	Number of AWW height measurements (Percentage of total Height measurements)	Cumulative Percent	Number of AWW weight measurements (Percentage of total Weight measurements)	Cumulative Percent	Number of AWW MUAC measurements (Percentage of total MUAC measurements)	Cumulative Percent
<1.00 %	180 (73.8%)	73.8%	134 (46.4%)	46.4%	41 (14.4%)	14.4%
1.00 - 4.99%	56 (23.0%)	96.7%	131(45.3%)	91.7%	178 (62.5%)	76.8%
5.00 - 9.99%	7 (2.9%)	99.6%	15 (5.2%)	96.9%	46 (16.1%)	93.0%
>=10 %	1 (0.4%)	100.0%	9 (3.1%)	100.0%	20 (7.0 %)	100.0%
Total	244 (100.0%)		289 (100.0%)		285(100.0 %)	

As can be seen from the table the AWW height measurements are mostly in the <1.00% difference category (73.8 % of the measurements) while the weight and MUAC measurements have decreasing proportion of measurements in this category (46.4% and

14.4% respectively). 96.7% percent of the height measurements have a difference of less than 5 % compared to 91.7% and 76.8 % of the weight and MUAC measurements respectively. Conversely MUAC measurements have the largest percentage of measurements with a difference of 5.00 % or more and height measurements have the least percentage of measurements with greater than or equal to 5.00% difference.

5.3.2.3 Difference in Measurements between AWW and Validation Measurements: Bland Altman Analysis

The difference between AWW measurements and Validation measurements was further analysed using Bland Altman plots wherein the difference (Validation measurement – AWW measurement) was plotted against the average of the two measurements as shown in the graphs below:

Figure 8 Bland Altman Plot of height measurements

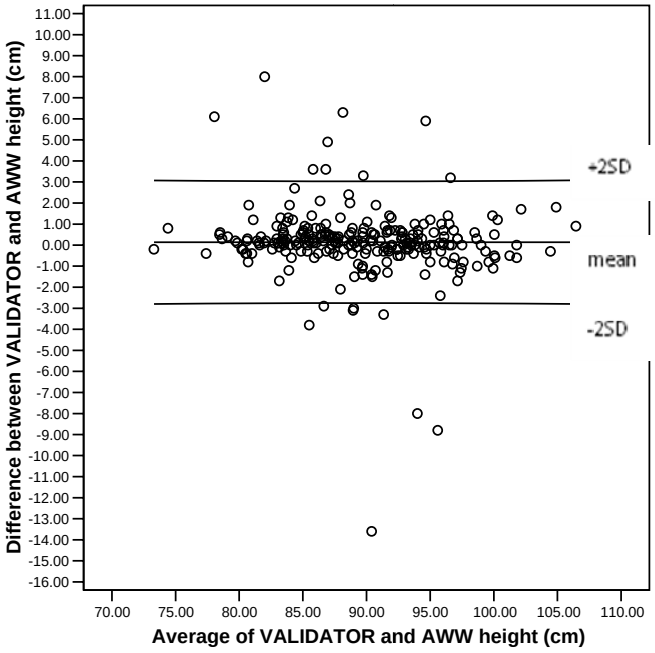


Figure 9 Bland Altman Plot of Weight measurements

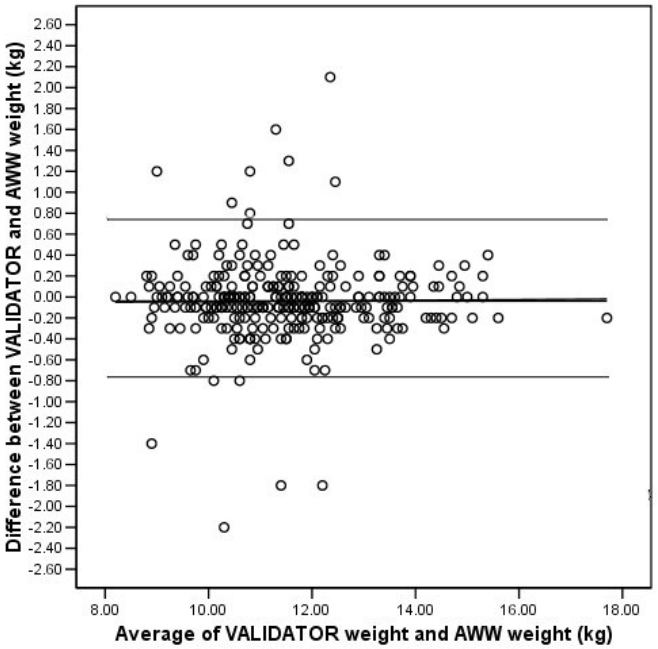
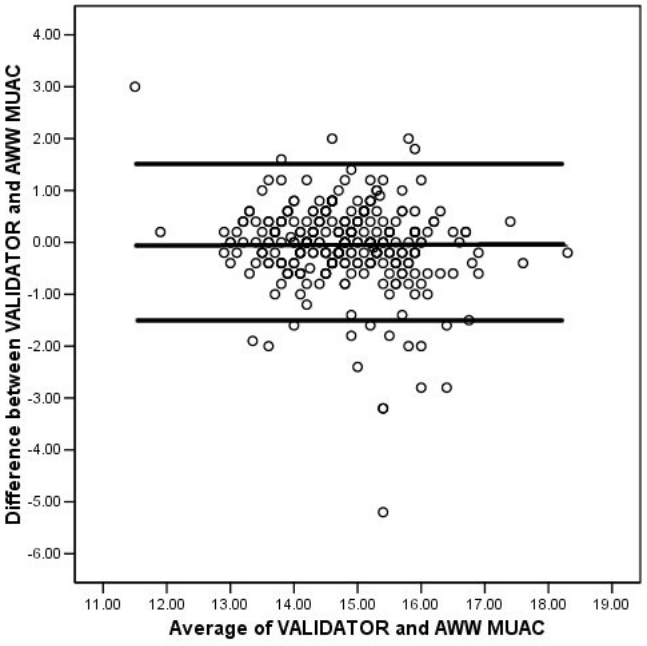


Figure 10 Bland Altman plot of MUAC measurements



The Bland-Altman plots show that the dispersion of plots is least for the height measurements and most for the MUAC measurements. The Mean +/- 2SD lines act as limits of agreement denoting the limits within which 95% of the plots, i.e. 95 per cent of the differences lie (52). For height measurements the differences lie between +/- 3.4 cm, for weight +/- 0.7 kg and for MUAC +/- 1.6 cm.

5.3.2.4 Difference in WHZ score between AWW and Validation Measurements

The resulting differences in WHZ score classification arising from the differences in measurements was then analysed. Using the AWW and Validation measurements, corresponding WHZ scores were calculated by WHO Anthro. The difference between these computer generated scores is given below:

Table 5.31Frequency Differences in WHZ between Validation and AWW measurements

Difference in WHZ score	Frequency	Percent
<1 difference	224	91.8
1-1.99	17	7.0
2-2.99	2	.8
3 and above	1	.4
Total	244	100.0

The results show that 91.8 per cent of the AWW measurements and corresponding Validation measurements resulted in WHZ scores that were less than 1 Z-score apart. A further 7 percent of measurements had a difference between 1.0 and 1.99. Leaving only 2.2 per cent of measurements more than 2 Z-scores apart.

5.3.3 Agreement in WHZ Score Categorization

The validity of the final Z-score categorization done by the AWWs was next analysed by measuring the agreement between categorization by the AWWs and the WHO Anthro computer programme. This was done by determining the kappa statistic, weighted kappa and percentage agreement between the WHZ scores which were recorded. The weighted kappa was calculated giving a factor of 1.0 for full agreement, 0.75 for the categorizations being 1 category apart, 0.25 for the categorization being 2 categories apart and 0.0 for the categorization being 3 or more categories apart.

5.3.3.1 Agreement between AWW classification and WHO Anthro classification based on AWW measurements

The agreement between the categorization of degree of wasting which was done by the AWWs and the categorization done by the computer programme using only measurements by the AWWs was done to see how well the AWWs were able to assign WHZ score categories for a given set of measurements. The agreement analysis is shown in the table below. The ability of the principal investigator to categorize WHZ scores as compared to the computer programme based on validation measurements was also determined for comparison with the AWWs. The results are shown below.

Table 5.32 Statistics measuring ability to categorize WHZ by AWW and Principal Investigator

	Agreement between AWW categorization and Anthro categorization based on AWW measurements	Agreement between categorization by Principal investigator and Anthro categorization based on validation measurements
Kappa	0.55	0.85
Weighted Kappa	0.66	0.90
Percentage agreement	89%	89%

The results show that the AWWs had 89% agreement with the computer programme in classification but the Kappa was 0.5 and weighted Kappa was 0.66. While the classification by the principal investigator had similar agreement of 89% as the AWWs with the computer programme, the Kappa and weighted Kappa were higher at 0.85 and 0.90 showing agreement in the validation classification was less due to chance than that of the AWWs.

5.3.3.2 Agreement between AWW categorization based on AWW measurements and WHO Anthro categorization based on Validation measurements

In order to measure the ability of the workers to identify SAM in children correctly, the categorization done by the AWWs based on their own measurements was compared with the categorization done by the WHO Anthro computer programme based on measurements by the principal investigator. Categorization by the computer programme WHO Anthro based on validation measurements was considered the gold standard. The results were as follows:

Kappa = 0.41

Weighted Kappa = 0.60

Agreement = 58%

5.3.3.3 Agreement between WHO Anthro classification based on AWW measurements and WHO Anthro classification based on Validation measurements

In order to ascertain the validity of the prevalence of SAM and wasting found in the study, the agreement between categorization done by WHO Anthro based on AWW measurements (which is how the prevalence was determined) and the categorization done by WHO Anthro based on validation measurements was:

Kappa = 0.50

Weighted Kappa = 0.65

Agreement = 61%

5.3.4 Validity of Identification of SAM

Lastly the validity of the diagnosis of SAM by the workers was measured by calculating the sensitivity and specificity of the categorization they made during the survey as compared to the categorization made by WHO Anthro on the validation measurements:

Table 5.33 2 x 2 table of diagnosis of SAM

		Anthro Z scores on validation measurements		TOTAL
		SAM present	SAM absent	
AWW diagnosis of SAM on AWW measurements	SAM present	2	2	4
	SAM absent	3	237	240
	TOTAL	5	239	244

The validity of the AWW identification of SAM as compared to the gold standard of WHO Anthro categorization on validation measurements was found to be:

Sensitivity: 40%

Specificity: 99.1%

Positive predictive value: 50%

In order to determine where the misclassification of children with SAM by the AWWs occurred the following analysis was done to identify what nutritional status was given for children who were falsely labeled as not having SAM by the AWWs:

5.34 Table of diagnosis of SAM, MAM and no wasting

		Anthro Z scores on validation measurements			TOTAL
		SAM WHZ <-3	MAM WHZ -2 to -3	No wasting WHZ >= -2	
AWW diagnosis of SAM and MAM on AWW measurements (WHZ <-2)	SAM WHZ < -3	2	0	2	4
	MAM WHZ -2 to -3	3	30	17	50
	No wasting WHZ >= -2	0	17	173	190
TOTAL		5	47	192	244

The table shows that the children in the validation sample who had SAM by the gold standard were misclassified as having Moderate Acute Malnutrition (MAM) by the AWWs. A diagnosis of MAM or SAM would have identified correctly all the children who actually had SAM.

5.3.5 Validity of AWW Diagnosis of Wasting

The same analysis was done to measure the diagnosis of wasting, taken as a WHZ < -2.

Table 5.35 2 X 2 table of diagnosis of wasting

		Anthro Z scores on validation measurements		TOTAL
		WHZ <-2	WHZ >= -2	
AWW diagnosis of wasting (WHZ <-2)	WHZ < -2	35	19	54
	WHZ >= -2	17	173	190
	TOTAL	52	192	244

Sensitivity = 67.3%

Specificity = 90.1%

Positive Predictive value = 64.8%

It can be seen that as compared to the identification of SAM, the sensitivity and positive predictive value in identifying wasting are higher.

6 DISCUSSION

6.1 Discussion of Methodology

6.1.1 Instruments

The results of the study were heavily dependent on the instruments used to make measurements. Among the instruments used the height board alone was not standardized unlike the measuring tapes and the electronic weighing scale. Standardised manufactured height boards were not feasible for the study due to their cost and so a height board was made according to recommended WHO guidelines(45). The instruments used represent the best available options within the financial limits of the study. The height board could have been standardised against standardised manufactured instruments. This would have increased the validity of the prevalence that was found. The lack of standardisation of the height board did not affect the validation within the study because the same height board was used for the AWW measurements and the validation measurements almost concurrently. Any systematic error from the height board would have manifested in both AWW measurements and validation measurements resulting in the same differences in height measurements regardless of any systematic error in the height board. Thus the validation part of the study remains valid. Differences between AWW measurements and validation measurements can be ascribed to inter observer variation resulting from modifiable differences in anthropometric technique.

6.1.2 Curriculum

The curriculum was comprehensive and covered all the topics necessary to identify SAM in 2 to 5 year old children. These topics were condensed into a single training session lasting approximately 2 ½ hours held in the afternoon when the AWWs were available. The duration of each session was far beyond the expected attention span of each trainee. An

attempt was made to mitigate the effect of waning attention spans by interspersing demonstrations, practical exercises and videos in between interactive lectures. The volume of content was large for a single sitting. Both limitations in the course – long duration and amount of content in each session - could have been reduced by conducting the teaching sessions for shorter duration over more days instead of holding them all on the same afternoon. However this was not feasible due to the number of workers who required training within the time available. When considering what would be operationally feasible for the ICDS a similar limitation in time available for training AWWs is likely. The current training in growth monitoring during the initial training of AWWs is also limited to a single afternoon of 2 hours duration (out of a whole month of classes)(53). Thus the course could have been improved by spreading out the teaching sessions but it is closer to what is operationally feasible in its current time frame.

6.1.3 The Anganwadi Workers

The results from the training data indicate that the AWWs in the Vellore ICDS Urban Project represent are predominantly a middle aged group of women aged above 50 years (Tables 5.1 and 5.2). Age related physical limitations were present, influencing the measurements in the prevalence survey. For example 6 of the 40 workers who took part in the prevalence survey could not measure height because the requirement to kneel or squat down repeatedly caused unbearable knee pain. Refractive errors were also common, and would have influenced the measurement of height and MUAC (due to small divisions on the scale and small print) and plotting points on the reference charts for assigning WHZ-score categories. In these respects the group that took part in the study presented physical challenges which limited the accuracy of their findings. These challenges are present in any ICDS project consisting of AWWs of similar age distribution and as such the findings of the study present what can be realistically expected from similar ICDS Projects. When generalizing the findings of the study to ICDS

projects consisting of a younger group of AWWs one would expect a higher level of accuracy than that found in this study. Thus the study presents what can be realistically expected from AWWs or a worst case scenario with a level of accuracy below which other ICDS projects are unlikely to fall.

6.1.4 Assessment

The practical assessment was done by using a check list to mark the technique used by Anganwadi workers in taking measurements. The values of their measurements were not used in the marking system. In order to standardize the workers better before the survey their measurements could have been marked against a set of validation measurements and AWWs who were found to have measurements outside the acceptable range could have been retrained and reassessed to standardize the AWWs before the prevalence study. In short a validation and retraining process could have been incorporated into the training course itself before the survey was done. However such an extension of the training course was not feasible within the time available for doing the course and is unlikely to be operationally feasible in the ICDS.

The validity of the practical assessment would have been improved if an independent evaluator was used to mark the technique used by the AWWs in the practical assessment. This would have reduced possible bias in determining the effect of the training course.

6.1.5 Training to categorize and record WHZ scores

The objective of the training course which was unfulfilled was training Anganwadi Workers to read the WHO growth charts to categorize and then record correctly the WHZ score for a set of measurements. This is supported by data given in tables 3.9 and 3.10. While the training manual provided information on categorization and recording of WHZ score and the course included exercises on categorization, there were no written examples in the training

manual. Such written exercises would have provided examples which AWWs could have referred back to or studied during the training course. Having such written examples and exercises would be a necessary improvement to the training manual.

Because the training objective of categorizing and recording WHZ scores was not met, a retraining was given during each camp. Conducting such a retraining would not have been feasible for the ICDS programme where the AWWs would be expected to do a survey on their own. And so a retraining in categorization would have to be done as part of the training course and could be done on the same day as the course.

6.1.6 Bias in the Survey

There was the possibility of bias on the part of Anganwadi workers towards underestimating the prevalence of SAM as the presence of these children would seem to indicate a failure of the AWWs to provide adequate nutrition or refer malnourished children. Thus an AWW may have given higher weights and lower heights for children in her care. Steps taken to prevent such a bias included:

- Sensitising the workers to the importance and impact of identifying children with SAM. An attempt was made to change attitudes of the workers to focus on doing their best so that not a single child with SAM would be missed.

- The validation was kept random and independent of the AWWs measurements. The workers were unable to predict which of their measurements were being used to assess them and so there was no basis on which to choose children whose measurements could have been manipulated.

- During the survey, some AWWs took measurements for children who were under the care of another AWW. This was done when an AWW was ‘in charge’ of an extra

AWC in addition to her own AWC due to vacancies within the project. An additional AWW from another centre within the project was called in to the camp to take measurements for the extra AWC. This was done in order to maximize the number of AWWs validated during each camp. It also had the effect of providing a more independent evaluation of the nutrition status of children in a given centre as AWWs from another centre were likely to have less bias while measuring children who they were not responsible for. This approach could have been expanded for the whole survey to reduce bias by having all children in an AWC measured by AWWs who were responsible for a different AWC in the project. The feasibility of conducting the whole survey this way would depend on the availability of AWWs within the project.

6.2 Discussion of Validation – the Differences between AWW and Validation measurements

The results show that 40 out of the 57 workers who were trained were validated during the survey. Consisting of 70% of the workers, these 40 have been considered representative of AWWs in the project. On average 47% of children per AWC were validated, ranging between 19% and 100% and so the percentage of measurements validated is considered adequate to assess each AWW's performance.

6.2.1 Percentage difference in measurements

Figures 7, 8 and 9 show that the differences between the AWW measurements and the validation measurements all followed a Normal distribution . The percentage difference in measurements was the first parameter used to evaluate the accuracy of measurements by the AWWs. Table 3.25 shows that the measurements had a median difference of 0.50%, 1.11% and 2.67 % for height, weight and MUAC respectively. The standard deviations for percentage difference were 1.74%, 2.96% and 4.48% respectively. As the differences were

normally distributed, 95% of the differences are expected to lie within +/- 3.5%, 5.9% and 9.0% for height, weight and MUAC respectively. Thus the percentage difference was found to be low for height and weight measurements. They were considered to be of adequate accuracy for the purpose of detecting SAM. MUAC measurements had the highest percentage difference. Although the MUAC measurements neared a difference of +/- 10% they were still considered to have acceptable accuracy for the purpose of the survey.

In terms of how accurate the measurements were compared to each other, tables 3.25 and 3.26 show that height measurements had the least percentage difference in terms of magnitude of percentage difference and dispersion around the mean, followed by weight measurements and MUAC had the largest percentage difference.

MUAC can be expected to have the largest difference as it is highly dependent on the technique of measuring. The MUAC measurement depends principally on the tightness to which the measuring tape is pulled as it encircles a child's arm. Although guidelines exist to standardize the technique there will be variations in terms of each person's interpretation of what is 'too tight' and 'too loose'. A further source of variation is the AWWs limitation in terms of sight. Although the measuring tapes were standardized, the print within the tapes was quite small and as has been mentioned earlier most of the AWWs had refractive errors which could have lead to inaccuracies in reading the tapes even if they pulled the tape to the correct tightness.

The percentage height difference was less than the percentage weight difference. One would expect height to be less accurate and therefore have higher difference than weight measurements because of the technique involved. Accuracy is harder to achieve in height than weight because:

1. Correct position is harder to achieve while measuring height than while measuring weight.

2. There is no alternative to measure height when a child is uncooperative than to either not count the measurement or take the best available measurement. In weight measurements tared weighing is an option which produces reasonably accurate weights even if the child will not stand still.

3. The number of steps required to be correctly remembered and done for height measurements was more than for weight.

4. Measuring height always requires the assistance of another person to hold the child's feet. In the study setting this person was usually the AWC helper or the mother of the child who may not follow instructions correctly as compared to a person trained in anthropometry.

5. In the study setting the AWWs were already familiar with measuring weight and so would have been more familiar with the principles involved whereas height measurement was a new technique for them and the requirements to obtain accuracy were unfamiliar.

The lower percentage difference in height compared to weight may be explained by the larger denominator involved while calculating the percentage difference in height as compared to percentage difference in weight. As a proportion of the total magnitude of validation measurements the differences in height are small as compared to weight difference. And so the percentage difference in height would be less. Consequently the width within 2 standard deviations of the height measurements is less for percentage height compared to percentage weight. When considering absolute difference the width within 2 standard deviations for

height is +/- 3.4 cm as compared to +/- 0.7 kg for weight. As height is measured to 0.1 cm and weight to 0.1 kg this represents a larger difference in height measurements in terms of the number of units of measurement. In conclusion, while height measurements had lower percentage difference than weight measurements, the weight measurements were more accurate in terms of the difference in number of units of measurement.

6.2.2 The Bland Altman Analysis

The Bland Altman plots were used to interpret the absolute difference between measurements. This is done by plotting the difference between corresponding measurements against the average of corresponding measurements. The Bland Altman plots are given in Figures 10, 11 and 12. It can be seen that the variation in difference follows the order of being least in height measurements, followed by weight measurements and finally most in MUAC measurements as the dispersion of plots around the mean increases from height to weight to MUAC. For all three parameters, the outliers tend to be in the middle of the range of measurements rather than at the extremes. This could be because of a larger number of measurements in the middle range leading to a higher chance of errors being made. Discounting the outliers, the plots seem to be more disperse towards the higher ranges of the measurements in height and weight. This indicates less agreement for larger measurements. MUAC on the other hand seems to have less dispersion at the higher values, indicating more agreement in the larger measurements of MUAC.

As stated in the results the limits of agreement from the validation sample were the values corresponding to the Mean +/- 2 standard deviations of the difference found within the sample. For height this was found to be 3.4 cm, for weight 0.7 kg and for MUAC +/- 1.6 cm. Taken as such the differences in height and weight seem to be very large, extending up to almost 3.5 cm for height and over half a kg difference for weight. The effect that these differences would have on the final WHZ score was then determined.

6.2.3 Difference in WHZ score between AWW and Validation Measurements

After analyzing the differences in measurements, the effect of these differences on the WHZ score was analysed. The exact WHZ score for each pair of validation and AWW measurements was generated using the WHO Anthro computer programme and the difference in WHZ score were calculated. Table 3.28 gives the distribution of the differences found. 91.8% of the differences were within one WHZ score. Only 1.2% of measurements resulted in a difference of more than 2 WHZ categories. The results show that most of the AWW measurements resulted in a WHZ score that was within one standard deviation of the corresponding WHZ score derived from validation measurements. It is suggested that this is an acceptable level of difference.

6.3 Discussion of Validation – Agreement in WHZ score categorization

6.3.1 Accuracy of the AWWs in Assigning Z-scores: Agreement between AWW Categorization and WHO Anthro Categorization based on AWW Measurements

The first analysis of agreement on WHZ categorization was done to judge how well the AWWs were able to categorize their own measurements. This was done by examining the agreement, Kappa statistic and weighted Kappa statistic derived from the WHZ category that AWWs assigned during the survey and the WHZ category that was assigned by the WHO Anthro computer programme on the same AWW measurements. The results in table 3.29 indicate that a high level of agreement was found at 89%. When taking into account agreement due to chance the agreement falls giving a Kappa of 0.55. This level of Kappa however does indicate an intermediate to good agreement(54). The weighted Kappa gave weightage for agreement that was closer to complete agreement, and was found to be 0.66. For the purpose of comparing the Anganwadi workers with another ‘fallible human’ in terms of the ability to assign WHZ scores, the agreement between the WHZ categories assigned by

the principal investigator on the validation measurements and the WHZ categories assigned by the Anthro computer programme was also analysed and presented. This analysis showed an exactly similar percentage agreement of 89% however the Kappa statistic was much higher at 0.85 indicating excellent agreement beyond chance(54) and weighted Kappa was 0.90. The conclusion is that while the AWWs showed intermediate to good agreement in assigning WHZ score categories, there was room for improvement in terms of what was humanly possible. As has been discussed before probably the single biggest factor determining the AWWs ability to assign WHZ scores for a given set of measurements accurately is their eye sight which for most workers was affected by refractive errors which may or may not have been adequately corrected by spectacles. 80.7 % of the AWWs trained had refractive errors. Related to the eye sight affecting the categorization is the fact that most of the AWCs had poor lighting indoors. Only a handful of the AWCs had ideal lighting provided by adequate sunlight or electrical connections. Even if they did have an electrical light, none had generator back up during the extensive day time power cuts that were experienced during the survey on a daily basis. It is suggested that poor vision compounded by poor lighting resulted in the inability of the workers to categorize measurements into WHZ scores as accurately as the principal investigator but the ability of the workers to categorize can be considered intermediate to good.

6.3.2 Accuracy of AWWs in assessing nutritional status: Agreement between AWW WHZ Categorization of AWW measurements and WHO Anthro WHZ Categorization of Validation measurements

The next analysis of agreement was done to measure how accurately the AWWs were able to assign the correct WHZ for a given child as compared to a gold standard of computer generated WHZ categories based on validation measurements for the same child. This analysis measured the accuracy of the final product of the AWWs ability to measure correctly

and their ability to assign WHZ categories correctly as compared to the gold standard of measurements by the principal investigator and computer generated WHZ categories. The resulting agreement was 58%, Kappa was 0.41 and weighted Kappa was 0.60. This agreement is still in the range of intermediate to good agreement with the Kappa being just greater than 0.40 (54) but the weighted Kappa was well in the good agreement range at 0.60. This suggests that the ability of the AWWs to identify correctly the WHZ score of a given child achieved an acceptable level of accuracy.

6.4 Discussion of validity of identification of SAM

The final analysis of the validation part of the study examined the sensitivity, specificity and positive predictive value of the AWWs identification of children with SAM as compared to the gold standard of computer generated WHZ scores based on validation measurements in identifying children with SAM. At the outset it should be noted that the prevalence of SAM, going by the gold standard of diagnosis, was relatively low at 5 out of 244 children i.e. 2% (table 3.30). This limits the degree of certainty that can ascribed to inferences from the validation data as far as SAM is concerned.

The results in table 3.30 show that the sensitivity was 40%, specificity was 99.1% and positive predictive value was 50%. Taken at face value the sensitivity is low, but not negligible. The analyses so far have shown acceptable accuracy of measurements and acceptable categorization of WHZ scores based on the AWW measurements and so one would expect the sensitivity to be reasonably good. The fact that the sensitivity is low in spite of having good measurements can be accounted for by noting that the accuracy of measurements has been determined by examining the differences between pairs of measurements whereas the sensitivity of the AWWs in identifying children with SAM relies on perfect agreement along exact categories. Two measurements may not be far apart and yet

may differ enough to result in two WHZ scores lying on either side of the line dividing two WHZ categories such as SAM and non SAM. Similarly with Kappa statistics, especially with the weighted Kappa, close agreement but not total agreement is still given weight whereas in the sensitivity of detection of SAM, as far as children who have SAM are concerned the AWW's diagnosis is either a true positive or a false negative and there is no weightage for a diagnosis that is almost correct but still wrong.

These explanations are supported by the data in table 3.31 which shows that all the children in the validation sample who actually had SAM but were missed by the AWWs were classified as WHZ -2 to -3, i.e. the adjacent WHZ category to SAM. The categorization of these children was almost correct (weightage given in weighted Kappa) but was still incorrect (false negative in sensitivity analysis). Table 3.31 also shows that the children identified as having MAM or SAM (i.e. WHZ category less than -2) by the AWWs included all the children who actually had SAM. This suggests that if at least all the children identified by the AWWs as having a WHZ of less than -2 are referred for further evaluation in a clinical setting, all the children in the AWCs with SAM would be identified by the more accurate measurements and WHZ categorization available in a clinical setting.

All the analysis of the results from the validation thus far have indicated that with the limited instruments available, within the limits of the training course provided, in spite of the challenges to accurate anthropometry and nutritional assessment posed by physical characteristics of the group of AWWs and their centres, the AWWs were able to make measurements to a reasonable degree of accuracy, categorize WHZ and assign nutritional status to an intermediate to good level of agreement with the gold standard and were able to correctly identify 40% of the children who had SAM within the validation sample as having SAM and 100% of the children who had SAM as either having MAM or SAM. It is therefore suggested that the identification of SAM by the AWWs is both feasible and worthwhile

within the ICDS project that was studied, especially if all the children identified as having a WHZ score of less than -2 are referred for further evaluation. Given the challenges to accuracy present in the study it is suggested that a project with a better height board, younger AWWs, and a revised training course with a greater emphasis on WHZ score categorization can be reasonably expected to yield higher diagnostic accuracy.

6.5 Discussion of validity of identification of wasting

Table 3.32 shows that the sensitivity, specificity and positive predictive value of identification of wasting were 67.3%, 90.1% and 64.8% respectively. It should be remembered that while the sensitivity was not 100 per cent, the children identified as having wasting by the AWWs included all the children who had SAM, i.e. the most wasted children were not missed. While the main thrust of this study has been on the identification of SAM, the wider scope of application to the ICDS and its aim of ensuring adequate nutrition to children in its care merits the suggestion that identifying children with wasting in the ICDS is feasible, valid and important and therefore deserves consideration for implementation in the ICDS.

6.6 Discussion of Prevalence

6.6.1 Demographic features

The demographic data of the children provided in tables 5.11, 5.13, 5.14 and 5.15 indicate that the children were mostly around 3 years of age and came from a lower Socio Economic Status background as evidenced by the predominance of unskilled manual labour (and autodivers) among the fathers occupation and mothers who worked, large proportion of parents with 0 to 5 years education, with nearly 75% of parents having less than 10 years of

education. As the association between poverty and childhood malnutrition has been established in the literature review it stands to reason that the prevalence of malnutrition among the children from this lower socio economic category would be higher than expected from a representative sample of the general population.

6.6.2 Prevalence of Malnutrition

As compared to the rest of India and Tamil Nadu in NFHS 3 (8) and the HUNGaMa (19) study the prevalence of SAM and other forms of childhood malnutrition within the ICDS Project in this study are given below :

Table 6.1 Prevalence of Childhood Malnutrition in NFHS 3 and HUNGaMa compared with Vellore ICDS Urban project 2012

	Vellore ICDS Urban Project 2012 (children 2 – 5 years)	Tamil Nadu NFHS 3 (under 5 children)	All India NFHS 3 (under 5 children)	Prevalence in 100 focus districts HUNGaMa (under 5 children)	Prevalence in 6 best districts of the best states HUNGaMa (under 5 children)
Severe Wasting SAM (Weight for height Z score< -3 or MUAC < 115 mm)	3.7%	8.9%	6.4%	3%	5%
WASTING (Weight for Height Z score < -2)	22.3%	22.9%	19.8%	11.4%	13.5%
STUNTING (Height for Age Z score < -2)	39.3%	30.9%	48.0%	58.8 %	32.5%
UNDERWEIGHT (Weight for age Z score < -2)	42.8%	29.8%	42.57%	42.3%	21.9%

The data shows that in this study:

1. There was a lower prevalence of severe wasting and a similar prevalence of wasting as compared to NFHS 3 for India and Tamil Nadu.

2. There was a lower prevalence of wasting and similar prevalence of severe wasting as compared to the HungaMa study for the Focus districts and the Best districts.

3. There was a lower prevalence of stunting compared to the HungaMa Focus Districts and NFHS 3 All India level.

4. There was higher prevalence of stunting compared to the HungaMa Best Districts and NFHS 3 Tamil Nadu level.

5. There was a similar prevalence of underweight as compared to HungaMa Focus Districts and NFHS 3 All India level.

6. There was more prevalence of Underweight compared to the HungaMa Best Districts and NFHS 3 Tamil Nadu levels.

As compared to the rest of Tamil Nadu in NFHS3 the study population had a lower prevalence of severe wasting, similar prevalence of wasting and higher prevalence of stunting and underweight.

6.6.3 Population Attributable Risk of mortality due to SAM

Although severe acute malnutrition is not as prevalent as the other forms of malnutrition in the study it retains its importance through its much higher risk of mortality (3) and as such deserves specific attention from the ICDS. The population attributable risk of mortality from SAM, given a prevalence of 3.7% and relative risk of mortality of 9.4 is 23.7%. Interestingly the population attributable risk for Moderate Acute Malnutrition given a prevalence of 18.7% and relative risk of 3 is 27%. This indicates that because of its higher prevalence moderate acute malnutrition is of greater public health significance in the study population than SAM and as such deserves interventions at least as much as SAM. This gives further evidence

supporting an intervention directed at Moderate Acute Malnutrition (MAM) in addition to SAM such as referral for all children with WHZ less than -2.

6.6.4 Risk factors for SAM

The study shows that although the children are in a nutritional programme there are still levels of malnutrition comparable to the rest of Tamil Nadu and India. This is probably because the socio economic risk factors for malnutrition among the children act in opposition to the nutrition and services provided by the ICDS and the resulting level of malnutrition represents the end result of these two forces acting against each other. The Chi square test of association showed a significant association between SAM and the risk factors of low maternal education ($p = 0.021$) and working mothers ($p = 0.004$). These are both risk factors for SAM which have been identified elsewhere (55)(56) . The data shows that they are influencing the nutritional status of children in the study population.

6.6.5 Absentees

The percentage of absentees was found to be 16%. As all the children were from the same locality the absentees were likely to have a similar socio economic status as the children who were surveyed. As has been described above, most of the children surveyed were shown to be from a lower socio economic status and so if the absentees were also from a low socio economic status the prevalence is unlikely to change.

6.6.6 MUAC

Only one of the MUAC measurements in the study was below 115 mm. This is to be expected as low MUAC tends to occur in younger children (5) as compared to low WHZ and the study was done among children aged 2 years and greater.

6.6.7 Pedal Oedema

None of the children in the study were found to have nutritional oedema. This is encouraging as pedal oedema indicates Kwashiorkor which is one of the severest forms of protein energy malnutrition.

6.6.8 Validity of the prevalence study

The validity of the prevalence study was measured by comparing the agreement between WHZ categorization generated by Anthro from AWW measurements and corresponding WHZ categorization generated by Anthro from validation measurements taken from the validation sample.

The results of the agreement showed that agreement was 61%, Kappa was 0.50 and Weighted Kappa was 0.65 indicating intermediate to good level of agreement and therefore the prevalence is considered to have an acceptable level of accuracy.

7 CONCLUSIONS AND RECOMMENDATIONS

From the results and analysis it is concluded that:

1. The identification of SAM by the AWWs is both feasible and valid within the ICDS project that was studied.

2. The prevalence of SAM in the study population was lower than the state and national level but wasting has similar prevalence.

3. SAM has public health significance in the urban area of Vellore.

In view of the public health significance of SAM and the validity of the AWW identification of children with SAM shown in this study it is recommended that the ICDS adopts the identification of SAM and wasting by the AWWs into its services with improvements in instruments and training course as suggested above.

In view of the public health significance of Moderate Acute Malnutrition and the data showing that children with SAM have been misclassified as having Moderate Acute Malnutrition, it is further suggested that every child found to be wasted, i.e. WHZ less than -2 should be referred to a clinical centre for further evaluation.

To improve accuracy in nutritional assessment the WHZ categorization could be done centrally by designated workers who have received further training in WHZ categorization for example the supervisors could be specially trained in WHZ categorization. The most accurate categorization would be done if the computer programme WHO Anthro was used by the ICDS. The computer programme is freely available but requires a basic desk top or laptop computer. Alternatively the programme can also be run on mobile devices such as smart phones which run on the Windows™ operating system or the Apple iOS™. This raises the

possibility of using WHO Anthro during camps and giving accurate WHZ scores as soon as the measurements have been taken.

8 BIBLIOGRAPHY

1. Pelletier DL, Frongillo EA, Schroeder DG, Habicht JP. The effects of malnutrition on child mortality in developing countries. Bull World Health Organ. 1995;73(4):443–8.

2. Pelletier DL, Frongillo EA. Changes in Child Survival Are Strongly Associated with Changes in Malnutrition in Developing Countries. J. Nutr. 2003 Jan 1;133(1):107–19.

3. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. The Lancet. 2008 Jan;371(9608):243–60.

4. Myatt M, Khara T, Collins S. A review of methods to detect cases of severely malnourished children in the community for their admission into community-based therapeutic care programs. Food Nutr Bull. 2006 Sep;27(3 Suppl):S7–23.

5. World Health Organization, United Nations Children's Fund. WHO child growth standards and the identification of severe acute malnutrition in infants and children A Joint Statement by the World Health Organization and the United Nations Children's Fund [Internet]. WHO; 2009. Available from: http://www.who.int/nutrition/publications/severemalnutrition/9789241598163/en/index.html

6. Isanaka S, Villamor E, Shepherd S, Grais RF. Assessing the Impact of the Introduction of the World Health Organization Growth Standards and Weight-for-Height z-Score Criterion on the Response to Treatment of Severe Acute Malnutrition in Children: Secondary Data Analysis. Pediatrics. 2009 Jan;123(1):e54 –e59.

7. Gross R, Webb P. Wasting time for wasted children: severe child undernutrition must be resolved in non-emergency settings. The Lancet. 2006 Apr 14;367(9517):1209–11.

8. National Family Health Survey (NFHS-3), 2005 - 2006: India: Volume I [Internet]. International Institute for Population Sciences (IIPS) and Macro International; 2007. Available from: http://www.rchiips.org/NFHS/chapters.shtml

9. ICDS Scheme in Tamil Nadu [Internet]. [cited 2012 Aug 16]. Available from: http://icds.tn.nic.in

10. WHO | Description Indtroduction [Internet]. WHO Global Database on Child Growth and Malnutrition. [cited 2012 Aug 17]. Available from: http://www.who.int/nutgrowthdb/about/introduction/en/index.html

11. WHO | Children: reducing mortality [Internet]. WHO. [cited 2012 Aug 17]. Available from: http://www.who.int/mediacentre/factsheets/fs178/en/index.html

12. Waterlow JC. Classification and definition of protein-calorie malnutrition. Br Med J. 1972 Sep 2;3(5826):566–9.

13. WHO | Description Child growth indicators and their interpretation [Internet]. WHO Global Database on Child Growth and Malnutrition. [cited 2012 Aug 17]. Available from: http://www.who.int/nutgrowthdb/about/introduction/en/index2.html

14. WHO | Description The Z-score or standard deviation classification system [Internet]. WHO. [cited 2012 Aug 17]. Available from: http://www.who.int/nutgrowthdb/about/introduction/en/index4.html

15. WHO Child Growth Standards: Anthropometry Training Video [Internet]. Available from: http://www.who.int/childgrowth/training/en/

16. Malnutrition Is Still a Major Contributor to Child Deaths - Population Reference Bureau [Internet]. [cited 2012 Aug 19]. Available from: http://www.prb.org/Publications/PolicyBriefs/Malnutrition.aspx

17. De Onis M, Brown D, Blossner M, Borghi E. Levels and Trends in Malnutrition UNICEF-WHO-The World Bank Joint Child Malnutrition Estimates [Internet]. United Nations Children's Fund, World Health Organization, The World Bank. UNICEFWHO- World Bank Joint Child Malnutrition Estimates. (UNICEF, New York; WHO, Geneva; The World Bank, Washington, DC;; 2012. Available from: http://www.who.int/nutgrowthdb/estimates/en/index.html

18. PROJECT INFORMATION DOCUMENT (PID) CONCEPT STAGE Report No.: AB5726 [Internet]. The World Bank; Available from: www.worldbank.org

19. HUNGaMa fighting hunger and malnutrition the HUNGaMa survey report 2011 [Internet]. Naandi Foundation; 2011 Jan. Available from: www.hungamaforchange.org

20. Dhar A. The HINDU: 42 per cent of Indian children are malnourished [Internet]. 2012 [cited 2012 Aug 21]. Available from: http://www.thehindu.com/todays-paper/article2791753.ece

21. Park K. Park's Textbook of Preventive and Social Medicine. 21st ed. Jabalpur: M/s Banarsidas Bhanot; 2011.

22. UNDP India: The Millennium Development Goals - Eradicate Extreme Hunger and Poverty [Internet]. [cited 2012 Aug 16]. Available from: http://www.undp.org/content/india/en/home/mdgoverview/overview/mdg1/

23. UNDP India: The Millennium Development Goals - Reduce Child Mortality [Internet]. [cited 2012 Aug 16]. Available from: http://www.undp.org/content/india/en/home/mdgoverview/overview/mdg4/

24. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, et al. What works? Interventions for maternal and child undernutrition and survival. The Lancet. 2;371(9610):417–40.

25. World Health Organization, World Food Programme, United Nations System Standing Committee on Nutrition and United Nations Children's Fund. Community-based management of severe acute malnutrition A Joint Statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children's Fund [Internet]. WHO; Available from: http://www.who.int/nutrition/publications/severemalnutrition/9789280641479/en/index.html

26. Bhan MK, Bhandari N, Bahl R. Management of the severely malnourished child: perspective from developing countries. BMJ. 2003 Jan 18;326(7381):146–51.

27. Bhatnagar S, Lodha R, Choudhury P, Sachdev HPS, Shah N, Narayan S, et al. IAP guidelines 2006 on hospital based management of severely malnourished children (adapted from the WHO Guidelines). Indian Pediatr. 2007 Jun;44(6):443–61.

28. Operational Guidelines on Facility Based Management of Children with SEVERE ACUTE MALNUTRITION [Internet]. 2011. Available from: http://mohfw.nic.in/NRHM/Documents/CH/Operational%20Guidelines%20on%20Facility%20Based%20Management%20of%20Children%20with%20Severe%20Acute%20Malnutrition.pdf

29. Gupta P, Shah D, Sachdev HPS, Kapil U. National workshop on “Development of guidelines for effective home based care and treatment of children suffering from severe acute malnutrition”. Indian Pediatr. 2006 Feb;43(2):131–9.

30. Collins S. Changing the way we address severe malnutrition during famine. The Lancet. 2001 Aug 11;358(9280):498–501.

31. WHO | The WHO Multicentre Growth Reference Study (MGRS) [Internet]. WHO. [cited 2012 Aug 19]. Available from: http://www.who.int/childgrowth/mgrs/en/

32. Integrated Child Development Services (ICDS) Scheme [Internet]. Government of India Ministry of Women and Child Development. [cited 2012 Aug 16]. Available from: http://www.wcd.nic.in/

33. De Onis M, Onyango AW, Borghi E, Garza C, Yang H. Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. Public Health Nutr. 2006 Oct;9(7):942–7.

34. Seal A, Kerac M. Operational implications of using 2006 World Health Organization growth standards in nutrition programmes: secondary data analysis. BMJ. 2007 Apr 7;334(7596):733.

35. Fact sheet on the implementation of 2006 WHO Child Growth Standards for emergency nutrition programmes for children aged 6-59 months [Internet]. IASC Global Nutrition Cluster, and Standing Committee on Nutrition (SCN) Task Force on Assessment, Monitoring, and Evaluation; 2009 [cited 2012 Aug 16]. Available from: http://oneresponse.info/GlobalClusters/Nutrition/publicdocuments/WHO%20GS%20Factsheet%20English.pdf

36. Berkley J, Mwangi I, Griffiths K, Ahmed I, Mithwani S, English M, et al. Assessment of Severe Malnutrition Among Hospitalized Children in Rural Kenya Comparison of Weight for Height and Mid Upper Arm Circumference. JAMA. 2005 Aug 3;294(5):591–7.

37. The Hindu : NATIONAL / KARNATAKA : 583 children in Udupi suffer from severe acute malnutrition [Internet]. [cited 2012 Aug 24]. Available from: http://www.thehindu.com/todays-paper/tp-national/tp-karnataka/article3652043.ece

38. Rajivan AK. Tamil Nadu: ICDS with a Difference. Economic and Political Weekly [Internet]. 2006 Aug 26 [cited 2012 Aug 16]; Available from: http://www.epw.in/integrated-child-development-services/tamil-nadu-icds-difference.html?ip_login_no_cache=5b592444cd549d7058439ccaed1d7894

39. Ministry of Women and Child Development. Integrated Child Development Services (ICDS) Scheme [Internet]. [cited 2012 Aug 20]. Available from: http://wcd.nic.in/

40. Ministry of Women and Child Development Government of India. Statewise details of Projects, AWCs, Beneficiaries, vacancy Position and nutrition Status of Children as on 31.03.2012 [Internet]. Ministry of Women and Child Development Government of India; 2012. Available from: http://www.wcd.nic.in/

41. Roles and Responsibilities of Anganwadi Workers [Internet]. [cited 2012 Aug 20]. Available from: http://www.swd.kerala.gov.in/index.php/juvenile-justice/410-roles-and-responsibilities-of-anganwadi-workers

42. NIPCCD. ICDS Training Programme [Internet]. GoI/MWCD/ICDS Training Unit; 2009. Available from: www.wcd.nic.in

43. _ ___National Institute of Public Cooperation and Child Development. Programme Content of Job Training of Anganwadi Workers [Internet]. Ministry of Women and Child Development Government of India; 2004. Available from: http://wcd.nic.in/icdstraining/icdstrainingcurriculam.htm

44. Vellore City Population Census 2011 [Internet]. [cited 2012 Aug 24]. Available from: http://www.census2011.co.in/census/city/472-vellore.html

45. WHO Department of Nutrition for Health and Development. Training Course on Child Growth Assessment WHO Child Growth Standards B Measuring a Child's Growth [Internet]. WHO; 2008. Available from: http://www.who.int/childgrowth/training/en/

46. TALC | Teaching-aids At Low Cost | Books and Educational Materials [Internet]. [cited 2012 Aug 24]. Available from: http://www.talcuk.org/

47. Abbatt FR. Teaching for better learning A guide for teachers of primary health care staff. 2nd ed. Geneva: Worl Health Organization; 1992.

48. Anthropometry Training Video [Internet]. WHO; Available from: http://www.who.int/childgrowth/training/en/

49. Annex 2: Mid - Upper Arm Circumference (MUAC) [Internet]. Nutrition Guidelines (MSF, 1995, 191p). [cited 2012 Aug 24]. Available from: http://www.nzdl.org/gsdlmod?e=d-00000-00---off-0fnl2%2e2--00-0----0-10-0---0---0direct-10---4-----stt--0-1l--11-en-50---20-about-muac--00-0-1-00-0--4----0-0-11-10-0utfZz-8-00&cl=search&d=HASH01850ad3b57a77757a999cec.6.2&gt=1

50. WHO | Weight-for-height [Internet]. WHO. [cited 2012 Aug 24]. Available from: http://www.who.int/childgrowth/standards/weight_for_height/en/index.html

51. WHO | WHO Anthro (version 3.2.2, January 2011) and macros [Internet]. 2011 [cited 2012 Aug 24]. Available from: http://www.who.int/childgrowth/software/en/

52. Bland JM, Altman DG. Agreed statistics: measurement method comparison. Anesthesiology. 2012 Jan;116(1):182–5.

53. _ ___National Institute of Public Cooperation and Child Development. Curriculum Content of Job Training Course of AWWs [Internet]. Ministry of Women and Child Development Government of India; 2004. Available from: http://wcd.nic.in/icdstraining/icdstrainingcurriculam.htm

54. Gordis L. Epidemiology. 4th ed. Saunders Elsevier; 2009.

55. Henry FJ, Briend A, Fauveau V, Huttly SA, Yunus M, Chakraborty J. Gender and age differentials in risk factors for childhood malnutrition in Bangladesh. Ann Epidemiol. 1993 Jul;3(4):382–6.

56. Henry FJ, Briend A, Fauveau V, Huttly SR, Yunus M, Chakraborty J. Risk factors for clinical marasmus: a case-control study of Bangladeshi children. Int J Epidemiol. 1993 Apr;22(2):278–83.

ANNEXURES

1. Christian Medical College Vellore Institutional Review Board approval
2. Originality Certificate
3. Letter to Tamil Nadu ICDS Principal Secretary/Special Commissioner
4. Weighing Scale
5. TALC MUAC insertion tapes
6. Infantometer/Height board
7. WHO Weight-for-Height Growth Charts for ages 2 to 5 years
8. Task Analysis
9. Course Curriculum
10. Lesson Plans
11. Training Manual
12. Knowledge Assessment Questionnaire
13. Practical Assessment OSPE Checklist
14. Anthropometric Data Proforma
15. Demographic Data Proforma
16. Child Health Card

ANNEXURE 1 - Christian Medical College Vellore Institutional Review Board approval

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

Dr.B.J.Prashantham, M.A.,M.A.,Dr.Min(Clinical)
Director, Christian Counseling Centre
Editor, Indian Journal of Psychological Counseling
Chairperson, Ethics Committee, IRB

Dr. Alfred Job Daniel, MS Ortho
Chairperson, Research Committee &
Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edi
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

March 7, 2012

Dr. [redacted]
PG Registrar
Department of Community Health
Christian Medical College
Vellore 632 002

Sub: **FLUID Research grant project NEW PROPOSAL:**
Identification of severe acute malnutrition among anganwadi children in the Vellore urban ICDS project area.
Dr. Verghese A Thomas, PG Registrar, Community Health, Dr. Kurien George, Dr. Jasmine Helen, Dr. Anuradha Bose, Community Health, Mr. Backiaraj, Programme Officer, ICDS

Ref: IRB Min. No. 7715 dated 12.12.2011

Dear Dr. [redacted]

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled "Identification of severe acute malnutrition among anganwadi children in the Vellore urban ICDS project area" on December 12, 2011.

The Committees reviewed the following documents:
1. Format for application to IRB submission
2. Information Sheet and Informed Consent Form (English)
3. Cvs of Drs. [redacted] Kurien George, Dr. Jasmine Helen, Dr. Anuradha Bose, Mr. Backiaraj, Programme Officer, Vellore.
4. A CD containing documents 1 - 3

The following Institutional Review Board (Ethics Committee) members were present at the meeting held on December 12, 2011 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore- 632002.

Name	Qualification	Designation	Other Affiliations
Dr. B.J.Prashantham	MA (Counseling), MA (Theology), Dr Min(Clinical)	Chairperson(IRB)& Director, Christian	Non-CMC

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

Dr.B.J.Prashantham, M.A.,M.A.,Dr.Min(Clinical)
Director, Christian Counseling Centre
Editor, Indian Journal of Psychological Counseling
Chairperson, Ethics Committee, IRB

Dr. Alfred Job Daniel, MS Ortho
Chairperson, Research Committee &
Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edin)
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

		Counselling Centre	
Mr. Harikrishnan	BL	Lawyer	Non-CMC
Mrs. S. Pattabiraman	BSc, DSSA	Social Worker, Vellore	Non-CMC
Mrs. Ellen Ebenezer Benjamin (on behalf of Dr. Jayarani Premkumar)	M.Sc. (Nursing), Ph.D.	Nursing Superintendent, CMC.	
Dr. Gagandeep Kang	MD, PhD, FRCPath.	Secretary IRB (EC)& Dy. Chairperson (IRB), Professor of Microbiology & Addl. Vice Principal (Research), CMC.	

We approve the project to be conducted as presented.

The Institutional Review Board expects to be informed about the progress annually of the project, any serious adverse events occurring in the course of the project, any changes in the protocol and the patient information/informed consent and requires a copy of the final report.

A sum of ₹ 20,000 (Rupees Twenty thousand only) is sanctioned for 6 months.

Yours sincerely

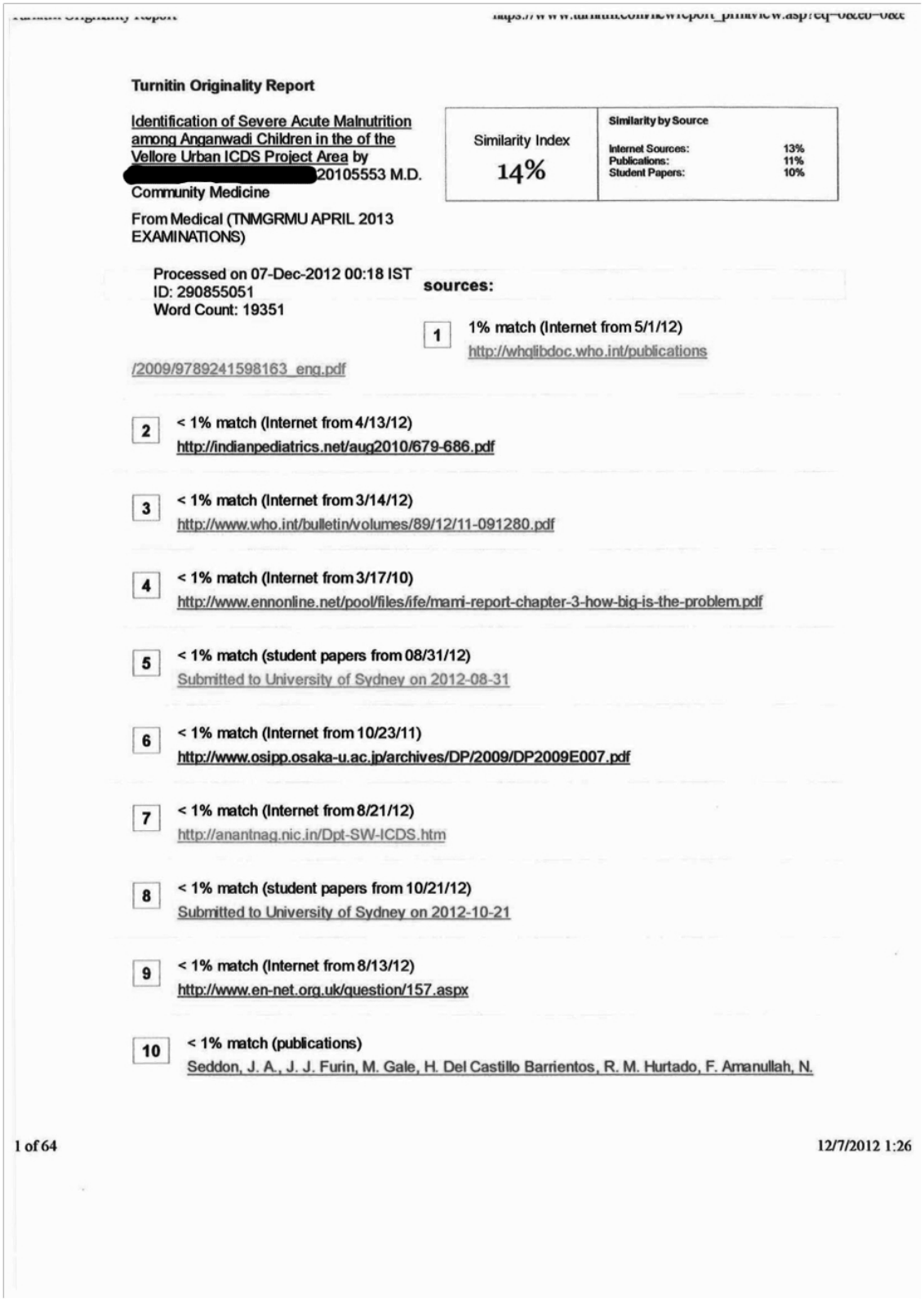
Alfred Daniel

Dr. Alfred Job Daniel
Principal& Chairperson (Research Committee)
Institutional Review Board

Chairperson (Research Committee) &
Principal
Christian Medical College
Vellore - 632 002, Tamil Nadu, India

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

ANNEXURE 2: Originality Certificate



Turnitin Originality Report

Identification of Severe Acute Malnutrition among Anganwadi Children in the of the Vellore Urban ICDS Project Area by [redacted]20105553 M.D. Community Medicine

From Medical (TNMGRMU APRIL 2013 EXAMINATIONS)

Processed on 07-Dec-2012 00:18 IST
ID: 290855051
Word Count: 19351

Similarity Index	Similarity by Source	
14%	Internet Sources:	13%
	Publications:	11%
	Student Papers:	10%

sources:

1 1% match (Internet from 5/1/12)
http://whqlibdoc.who.int/publications
/2009/9789241598163_eng.pdf

2 < 1% match (Internet from 4/13/12)
http://indianpediatrics.net/aug2010/679-686.pdf

3 < 1% match (Internet from 3/14/12)
http://www.who.int/bulletin/volumes/89/12/11-091280.pdf

4 < 1% match (Internet from 3/17/10)
http://www.ennonline.net/pool/files/ife/mami-report-chapter-3-how-big-is-the-problem.pdf

5 < 1% match (student papers from 08/31/12)
Submitted to University of Sydney on 2012-08-31

6 < 1% match (Internet from 10/23/11)
http://www.osipp.osaka-u.ac.jp/archives/DP/2009/DP2009E007.pdf

7 < 1% match (Internet from 8/21/12)
http://anantnag.nic.in/Dpt-SW-ICDS.htm

8 < 1% match (student papers from 10/21/12)
Submitted to University of Sydney on 2012-10-21

9 < 1% match (Internet from 8/13/12)
http://www.en-net.org.uk/question/157.aspx

10 < 1% match (publications)
Seddon, J. A., J. J. Furin, M. Gale, H. Del Castillo Barrientos, R. M. Hurtado, F. Amanullah, N.

1 of 64 12/7/2012 1:26

ANNEXURE 3: Letter to Tamil Nadu ICDS Principal Secretary/Special Commissioner

COMMUNITY HEALTH DEPARTMENT
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002
INDIA

CHTC

June 18, 2012

The Principal Secretary/Special Commissioner
Integrated Child Development Services Scheme
#1 Pammal Nallathambi Street
Taramani, Chennai – 113

Subject: Request for permission to use data obtained from Anganwadi workers and children enrolled in Vellore Urban Integrated Child Development Services Scheme Project Area for the Post Graduate dissertation of Dr Verghese A. Thomas.

Sir/Madam,

I hereby request you to allow my Post Graduate MD Community Medicine Student Dr [redacted] to use data obtained from Anganwadi workers and anthropometric data of children enrolled in the Vellore Urban ICDS Project Area for the purpose of his Post Graduate dissertation.

The dissertation will be submitted in partial fulfillment of the requirements of the Tamil Nadu Dr M.G.R. Medical University MD Community Medicine course.

The data is to be used for academic purposes only.

The data is to be collected with permission of the Vellore ICDS Project Officer during training and health check up conducted as part of a joint project of the Vellore District Integrated Child Development Services Scheme and the Community Health Department of Christian Medical College Vellore.

The justification, aims, scope, sample size, methodology and outcomes of the study are described in the attached document. Ethics committee approval for the study has been obtained from the Ethics Committee of the Institutional Review Board of Christian Medical College Vellore. Please see the attachment.

Thanking you,

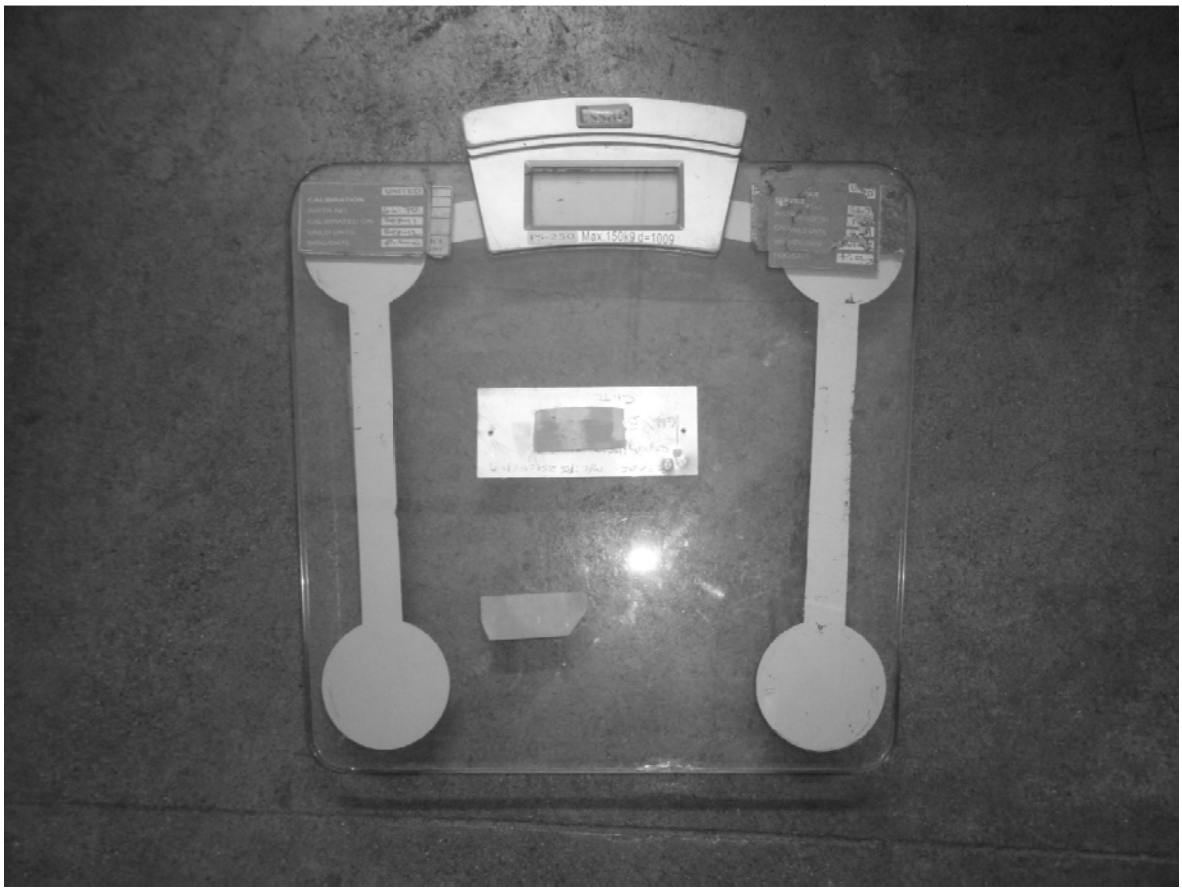
Yours Sincerely,

Dr Kuryan George,
Professor and Head,

Telephone : 91-416-2284207 / 2222102 Extn. 4207
Fax : Dept-91-416-2262268, College-91-416-2262788 / 91-416-2232035
Email: chad@cmcvellore.ac.in

ANNEXURE 4

Essae® Electronic Weighing scale Class III Model Number PS-250 Machine number PS 25005109, maximum weight 150 kg, precision 100g



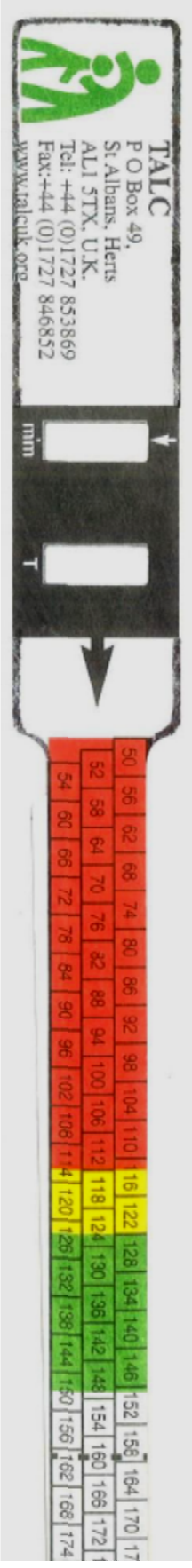
ANNEXURE 5

TALC Small Coloured Insertion Tape (MUAC) Original Grid View Style 115mm

Colour coded for Severe Acute Malnutrition cutoff of 115 mm.

Precision 0.2 cm

Cost UK pounds £0.25/- each (excluding shipping)



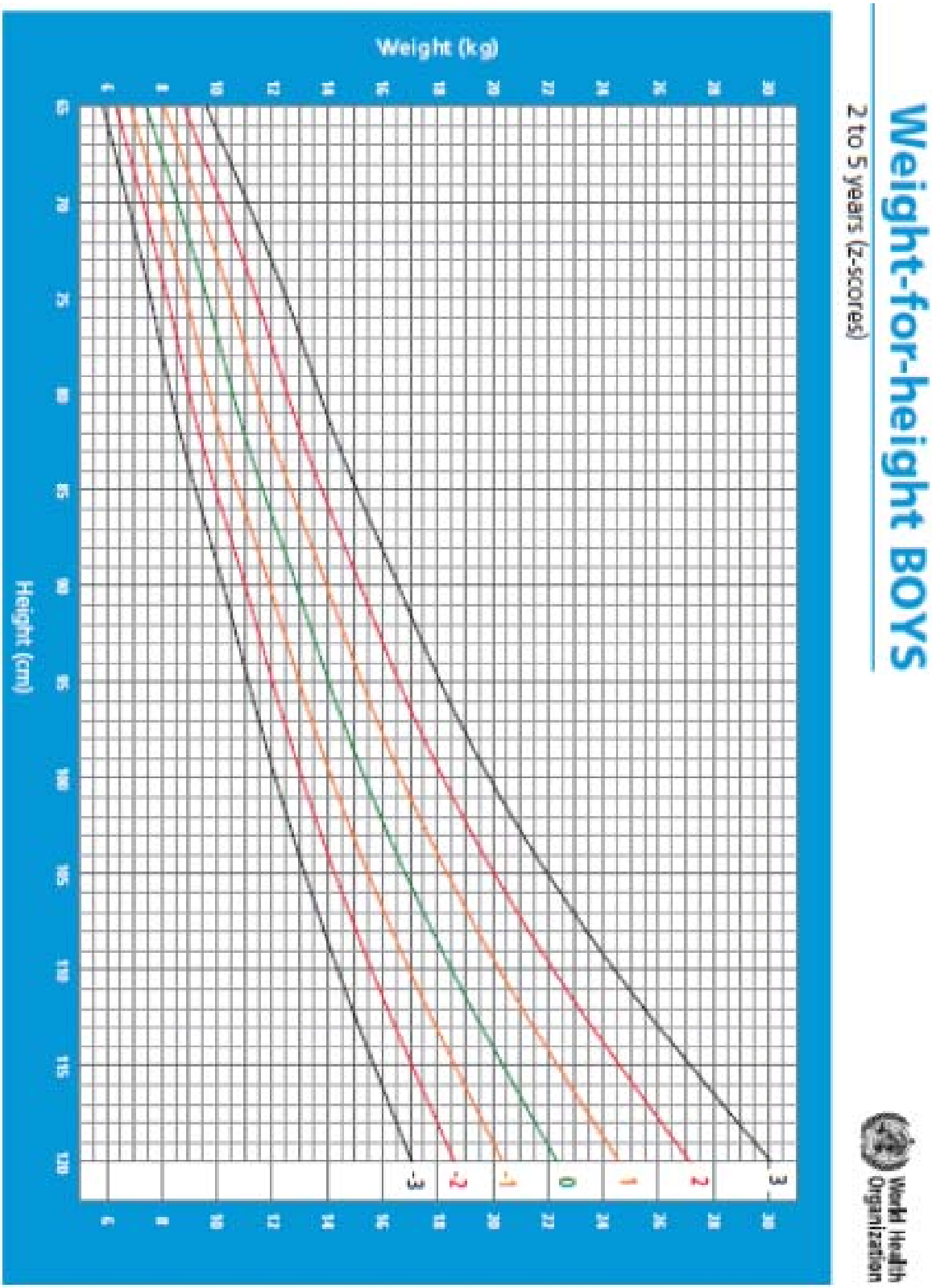
ANNEXURE 6

LOCALLY MADE INFANTOMETER/HEIGHTBOARD

Locally made in Vellore. Range up to 122 cm, precision 0.1 cm

Cost INR 3,435/-

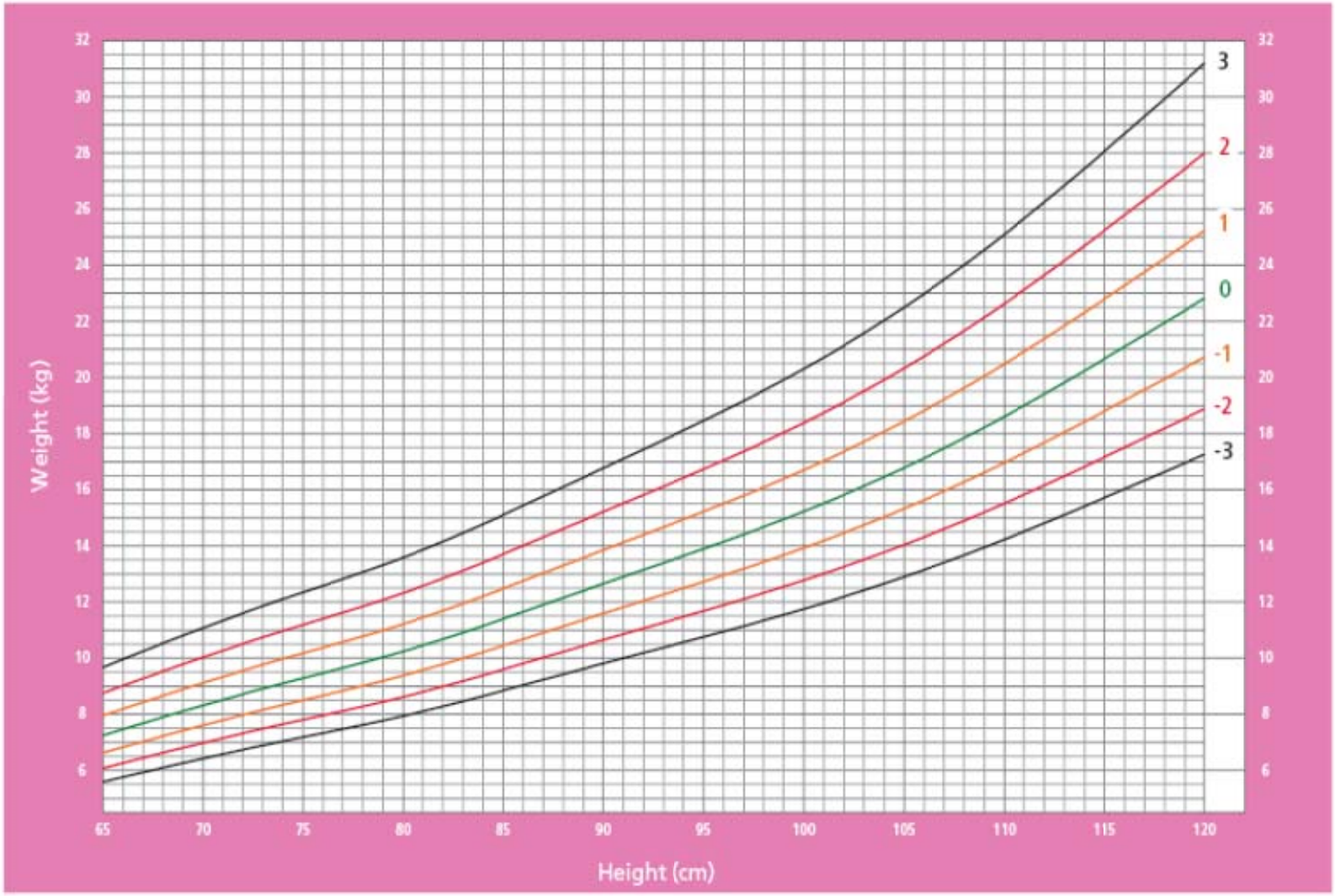
ANNEXURE 7 WHO Weight-for-Height Growth Charts for ages 2 to 5 years



Weight-for-Height GIRLS

2 to 5 years (z-scores)

World Health Organization



ANNEXURE 8: TASK ANALYSIS

TASK ANALYSIS FOR ANGANWADI WORKERS IN IDENTIFYING SEVERE ACUTE MALNUTRITION IN CHILDREN AGED 2 – 5 YEARS

TASK 1: EXAMINE CHILD FOR BILATERAL PEDAL EDEMA

SUBTASK	KNOWLEDGE	ATTITUDES
Ask the mother or helper to hold up the child	Bilateral pedal edema is a sign of severe underweight	Friendliness to mother
Take both feet in your hands	Bilateral oedema may be present even if weight and height are normal	Gentleness to child
Press gently with your thumbs on both feet for 3 seconds	Unilateral pedal oedema may be a sign of infection.	Concern for accuracy
Release thumbs and look for a pit or dent in the child's feet		Sympathy for mothers
Tell the mother if the child has bilateral swelling of the feet – has severe malnutrition		

TASK 2: WEIGHING THE CHILD ALONE

SUBTASK	KNOWLEDGE	ATTITUDES
Explain to the mother the reason for weighing	Measuring weight enables detection of malnutrition	Friendliness to mother
Explain to the child the child needs to stand still	Child needs to stand still on the scale to get an accurate result	Friendliness to children
Remove shoes and undress the child if not yet done	Shoes and clothes like jeans can weigh upto 0.5 kg and artificially increase weight	Gentleness to child
If the child resists being undressed, record that the child was clothed		Concern for accuracy
Remove hair ornaments that may interfere with measuring height	Hair ornaments can interfere with height. Measuring height needs to be done quickly after measuring weight	
Turn on the scale	.How to turn on the scale	
When 0.0 appears ask the child to stand on the scale on the middle of t he scale with the feet slightly	Scale measures accurately when subject stands in the centre	

apart and standing still		
Record the child's weight to the nearest 0.100 kg	Rounding to the nearest 0.100 kg	

TASK 3: WEIGHING THE CHILD USING TARED WEIGHING

SUBTASK	KNOWLEDGE	ATTITUDES
Explain to the mother the reason for weighing	Measuring weight enables detection of malnutrition	Friendliness to mother
Explain to the child the child needs to stand still	Child needs to stand still on the scale to get an accurate result	Friendliness to children
Remove shoes and undress the child if not yet done	Shoes and clothes like jeans can weigh upto 0.5 kg and artificially increase weight	Gentleness to child
If the child resists being undressed, record that the child was clothed		Concern for accuracy
Remove hair ornaments that may interfere with measuring height	Hair ornaments can interfere with height. Measuring height needs to be done quickly after measuring weight	
Turn on the scale	.How to turn on the scale	
When 0.0 appears ask the mother to stand on the centre of the scale. You or someone else should hold the child.	Scale measures accurately when subject stands in the centre	
When the weight is displayed record the mother's weight. Hand the child to the mother and ask her to remain still	Recording should be to 0.1 kg accuracy	
When the weight is displayed, record the total weight of the mother and child.		
Ask the mother to get off the scale		
Subtract the weight of the mother alone from the total weight of the mother and child to get the weight of the child. Record weight to nearest 0.1 kg		

TASK 4: PREPARE FOR MEASURING HEIGHT

SUBTASK	KNOWLEDGE	ATTITUDES
Be ready to measure height immediately after weighing while clothes are off		Concern for efficiency
Check that the child's shoes, socks and hair ornaments have been removed	These can make the measurement inaccurate	Concern for accuracy
Explain to the mother the need for checking height	Checking height helps detect malnutrition	
Explain the steps of the procedure to the mother	Know the steps of the procedure	
Answer any questions that the mother might have		
Tell the mother how she can help you	Mother is needed to soothe and comfort the child	
Explain that it is important to keep the child still and calm to get a good measurement		

TASK 5: MEASURE HEIGHT

SUBTASK	KNOWLEDGE	ATTITUDES
Help the child to stand on the baseboard in correct position	Parts of height board	Kindness
Ask the mother to hod child's knees and ankles to keep legs straight and feet flat, heels and calves touching the vertical board	Correct position on height board Back of head, shoulder blades, buttocks, calves, heels should touch the vertical board, not leaning back or forward	Gentleness
Ask mother to soothe the child and inform if the child moves out		Concern for accuracy
Position the head so that a line from ears to eyes is parallel to base of board. Hold the chin between your thumb and forefinger	Head must be straight.	
If necessary push on the stomach to help child stand straight.		

Keeping head in position use the other hand to pull down the headboard to rest on top of the head and compress the hair		
Read the measurement and record height in centimeters to the last 0.1 cm – the last line you can see		
If age is less than 2 years – add 0.7 cm and record height as length		

TASK 6: MEASURE MUAC

SUBTASK	KNOWLEDGE	ATTITUDES
Position the child	Measure muac on left arm with arm hanging lose at side	Kindness towards child
Locate the tip of the shoulder		Gentleness
Bend elbow and locate tip of elbow		Concern for accuracy
Stretch tape from tip of shoulder to tip of elbow, note distance.		
Find midpoint by dividing length by two and mark midpoint		
Position the arm hanging loose		
Put tape at midpoint at correct tension	Know correct tension	
Read circumference of arm and record		
Tell the mother if circumference is <115 mm – child is malnourished		Empathy

TASK 7: DETERMINE Z-SCORE

SUBTASK	KNOWLEDGE	ATTITUDES
Choose correct growth chart for boys and Girls	Boys and Girls have different growth charts	Concern for accuracy
Take weight and height from record		
Plot weight and height on chart		

Decide Z-score	Each curve on the graph corresponds to a number 3,2,1,0,-1,-2,-3 If the mark lies on or below the (-3) curve Z score is less than -3. If the curve lies in between any t wo curves Z score is said to be between the two curves.	
Record Z-score		

TASK 8: DETERMINE WHETHER CHILD HAS SAM AND REFER

SUBTASK	KNOWLEDGE	ATTITUDES
Read record sheet Z score MUAC Presence/absence of pedal edema		Concern for accuracy
Decide if child has SAM	Diagnostic criteria of SAM	
Record presence or absence of SAM in Record		
Refer any child with SAM to a doctor	Any child found to have SAM must be referred to a doctor	Concern for child

ANNEXURE 9 COURSE CURRICULUM

SAM IDENTIFICATION 2-5 YEARS TRAINING COURSE CURRICULUM

SAM IDENTIFICATION TRAINING: TEACHING SESSIONS

1. SAM
2. Examining child for pedal edema
3. Measuring weight
4. Measuring height
5. Measuring M.U.A.C.
6. Determining and Recording Z-score
7. Determining presence/absence of SAM

SAM IDENTIFICATION TRAINING: OBJECTIVES

By the end of the training each Anganwadi Worker should know:

1. what Severe Acute Malnutrition (SAM) is.
2. how SAM is caused
3. why it is important to identify children with SAM

By the end of the training each Anganwadi Worker should be able to:

1. examine a child for swelling of both the feet and record it.
2. measure a child's weight and record it.
3. measure a child's height and record it.
4. measure a child's mid upper arm circumference and record it.
5. Determine a child's weight for height Z-score from growth charts and record it.
6. Decide and record whether a child has Severe Acute Malnutrition.

S.A.M IDENTIFICATION TRAINING: TEACHING METHODS TO BE USED

Lecture – interactive with questions and answers

Practical demonstration

Practice sessions for works to practice procedures

Written Exercises in manual

Video demonstration of procedures

Power point demonstration of use of growth charts

Exercises on using growth charts

SAM IDENTIFICATION TRAINING: ASSESSMENT

Theory: pretest and post test objective multiple choice questions on SAM and anthropometric procedures

Practical: pretest and post test organized structured practical exam (OSPE) – demonstration of measurements of weight, height, MUAC and examination for pedal oedema.

Written exercise in determining Z-score

ANNEXURE 10

SAM IDENTIFICATION TRAINING: LESSON PLANS

LESSON PLAN SESSION 1: SAM

Learning objectives 1

Know what SAM means

Know why SAM is important

Know why identifying SAM is important and therefore why accurate measurements are important

Know the critera for determining SAM

Attracting the interest 1

Today we are going to learn about an important type of malnutrition. I know you have seen a lot of malnutrition in your work and you are very good at finding children who have malnutrition. But today I want to teach you how to find children who have a special type of malnutrition- severe acute malnutrition.

Have any of you heard of severe acute malnutrition?

Have any of you seen children lose weight very quickly? Why did the children lose weight quickly? What can be done for these children?

Key points 1

What is severe acute malnutrition?

Why is SAM important?

Why is it important to find children with SAM?

How can you identify a child with SAM? What are the criteria used?

What should be done for children who have SAM?

Activities

Interactive lecture

Assessment

Short written test.

LESSON PLAN SESSION 2: EXAMINING A CHILD FOR PEDAL EDEMA

Learning objectives 2

Performance objectives:

Examine a child for pedal edema

Record presence of pedal edema in data sheet and health card

Enabling objectives 2

Know that bilateral pedal edema is a sign of severe acute malnutrition

Know that bilateral pedal edema may be present even when weight and height are normal

Know where to look for pedal edema

Know how long to press the feet

Know what pitting looks like

Know that unilateral pedal edema is a sign of infection

Key points 2

Why is it important to look for bilateral pedal edema?

How do you look for pedal edema?

What should you do if you find bilateral pedal edema?

How do you record presence of bilateral edema?

Activities

Interactive lecture

Video

Practice

Assessment

Written test

OSPE

LESSON PLAN SESSION 3: WEIGHING A CHILD

Learning Objectives 3 Weighing a Child:

Performance objectives 3 Weighing a Child:

Measure a child's weight –with child standing alone and with mother

Record child's weight in data sheet and health card

Enabling objectives 3 Weighing a Child:

Know the parts of the electronic weighing machine

Know how to switch the machine on and off

Know how to prepare the mother and child for weighing

Know the correct position of the child on the machine

Know how to read weight and round to nearest 0.1 kg

Attracting attention 3 Weighing a Child:

How do you weigh children in your Anganwadi?

New way of measuring weight-

Any used electronic weighing machine before?

Which do you think is more accurate?

Key points 3 Weighing a Child:

What are the parts of the machine, how do you read it?

How do you turn the machine on and off?

How do you prepare children for weighing?

What are the steps in measuring a child with the electronic weighing machine?

To what level of accuracy do you record the weight?

How do you record the weight?

Activities 3: Weighing a Child

Interactive lecture

Demonstration

Practice

Assessment 3: Weighing a Child

OSPE

Written test: MCQs.

LESSON PLAN SESSION 4: MEASURING A CHILD'S HEIGHT

Learning objectives 4: Mesuring a Child's Height

Performance objectives 4: Measuring a Child's Height

Measure a child's height

Know how to record a child's height

Enabling objectives 4: Measuring a Child's Height

Know the correct age for measuring height

Know how to assemble the height board and move the cover

Know how to prepare the mother and child for measuring height

Know the correct position of the child on the height board

Know how to read height to the last complete millimetre

Attracting attention 4: Measuring a Child's Height

Have you ever measured height before?

How have you measured height before? Do you think it is reliable?

I'm going to show you a new way of measuring height.

Key Points 4: Measuring a Child's Height

What are the parts of the height board?

How do you assemble a height board?

How do you prepare a child for measuring height?

What are the steps in measuring height?

How do you read the height?

How do you record the height?

Activities 4: Measuring a Child's Height

Interactive Lecture

Demonstration

Practice

Assessment 4: Measuring a Child's Height

OSPE

Written test – MCQs

LESSON PLAN SESSION 5: MEASURING M.U.A.C.

Learning Objectives 5 Measuring M.U.A.C.

Performance objectives 5 Measuring M.U.A.C.

Measure M.U.A.C.

Know how to record M.U.A.C.

Enabling objectives 5: Measuring MUAC

Know what age M.U.A.C. is measured for

Know MUAC is measured in mm

Know the parts of the insertion tape

Know the correct arm and position for measuring M.U.A.C.

Know how to locate the bony landmarks for measuring M.U.A.C.

Know how to measure M.U.A.C.

Know the correct tightness to pull the tape for. Know what is too tight and what is too loose.

Attracting attention:

Which part of a child becomes thin first?

Key points 5 Measuring M.U.A.C.

Who can you measure M.U.A.C. for?

How do you measure M.U.A.C.?

How do you position a child for measuring M.U.A.C.?

How do you record M.U.A.C.?

Activities 5 Measuring M.U.A.C.

Demonstration of measuring tapes and MUAC

Demonstration of measuring M.U.A.C.

Practice measuring M.U.A.C.

Assessment 5 Measuring M.U.A.C.

OSPE

Written test – MCQs.

LESSON PLAN SESSION 6: DETERMINING AND RECORDING Z-SCORE

Learning objectives session 6: Determining and recording Z-score

Performance objectives session 6: Determining and recording Z-score

Plot weight for height on weight for height chart

Determine Z-score from the plot on chart

Record the Z-score

Enabling Objectives 6: Determining and recording Z-score

Know how to read a graph

Know the values of the curves on the chart

Know how to correlate the plot point with the value of the Z-score

Attracting attention

Have you all used the graph for weight for age?

Key points 6: Determining Z-score

Height is on the x axis and weight is on the y axis

Any plot below the lowest curve has <-3 Z score

The score for any plot above the lowest curve will have a value between the two curves

The Z-score is recording on health card and data sheet

Activity 6: Determining Z-score

Demonstration of Z-score on chalk board

Workers practice Z-scores in exercise book

Assessment 6: Determining Z-score

Written assessment – Plotting on a graph

Assigning Z-score for different plot points

SESSION 7: DETERMINING SAM

Learning Objectives session 7: determining SAM

Decide whether a child has SAM after complete examination

Enabling objectives session 7: determining SAM

Know the diagnostic criteria of SAM

Know what needs to be done for a child with SAM

Key points session 7: determining SAM

The criteria for SAM

Where to record SAM on data sheet and health card

A child with SAM should be referred to a doctor

Activity session 7:

Exercises on definitions

Assessment Session 7:

Written test: short answers

ANNEXURE 10: Training Manual

INTRODUCTION

This manual has been made for a training programme of the CMC Vellore Community Health Department-ICDS Vellore Urban Project Area Health Check Up 2012. It describes how Anganwadi Workers should examine and measure children in order to determine whether a child has severe acute malnutrition.

OBJECTIVES

By the end of the training each Anganwadi Worker should know:

4. what Severe Acute Malnutrition (S.A.M.) is.
5. how S.A.M. is caused
6. why it is important to identify children with S.A.M.

By the end of the training each Anganwadi Worker should be able to:

7. examine a child for swelling of both the feet and record it.
8. measure a child's weight and record it.
9. measure a child's height and record it.
10. measure a child's mid upper arm circumference and record it.
11. Determine a child's weight for height Z-score from growth charts and record it.
12. Decide and record whether a child has Severe Acute Malnutrition.

The measurements described in this module will be carried out by the Anganwadi workers for each child in their anganwadi during the health check up.

SECTION 1: SEVERE ACUTE MALNUTRITION

What is Severe Acute Malnutrition (S.A.M.)?

S.A.M. is a type of malnutrition which results from a child losing a lot of weight in a very short time. It is a classification of malnutrition for children from age 6 to 60 months who have severe wasting.

'Wasting' is a type of malnutrition in which children lose weight over a short time.

Children with wasting have grown to the same height as healthy children of the same age. However because they have lost weight very quickly, these children have much less weight than healthy children of the same height.

These children have a very low weight compared to the weight we expect them to have for the height they have grown.

How do children get Severe Acute Malnutrition?

Children get severe acute malnutrition because of

1) having another disease in their bodies for example TB

OR

2) because of a very quick and severe reduction in food intake because of shortage of food e.g. during cyclones

Why is Severe Acute Malnutrition Important?

Severe Acute Malnutrition is important because:

1) Children with SAM have a much higher risk of dying than children who do not have SAM. Children with S.A.M. have upto 9 times more risk of death than children who have only mild wasting. It is important to identify them so that they can get the treatment which will reduce their risk of dying.
2) Children who have S.A.M. gain weight faster when given special diets than when they are given the normal diet for children. It is important to identify them so that they can be given the special diet.

Because SAM is important, it is important to check and measure carefully to find children who have SAM.

How do we know whether a child has SAM?

A child has SAM if they have any of the following signs:

1) Swelling of both their feet

2) Weight for Height Z-score of less than -3
3) Mid Upper Arm Circumference of less than.

Note that a child only has to have **any ONE** of the signs to be classified as having SAM. Do not worry if you do not know what the terms ‘Weight for Height Z-score’ or ‘Mid Upper Arm Circumference’ mean. They will be explained in this manual.

What should be done for children who have SAM? Children who have SAM should be referred to a doctor immediately.

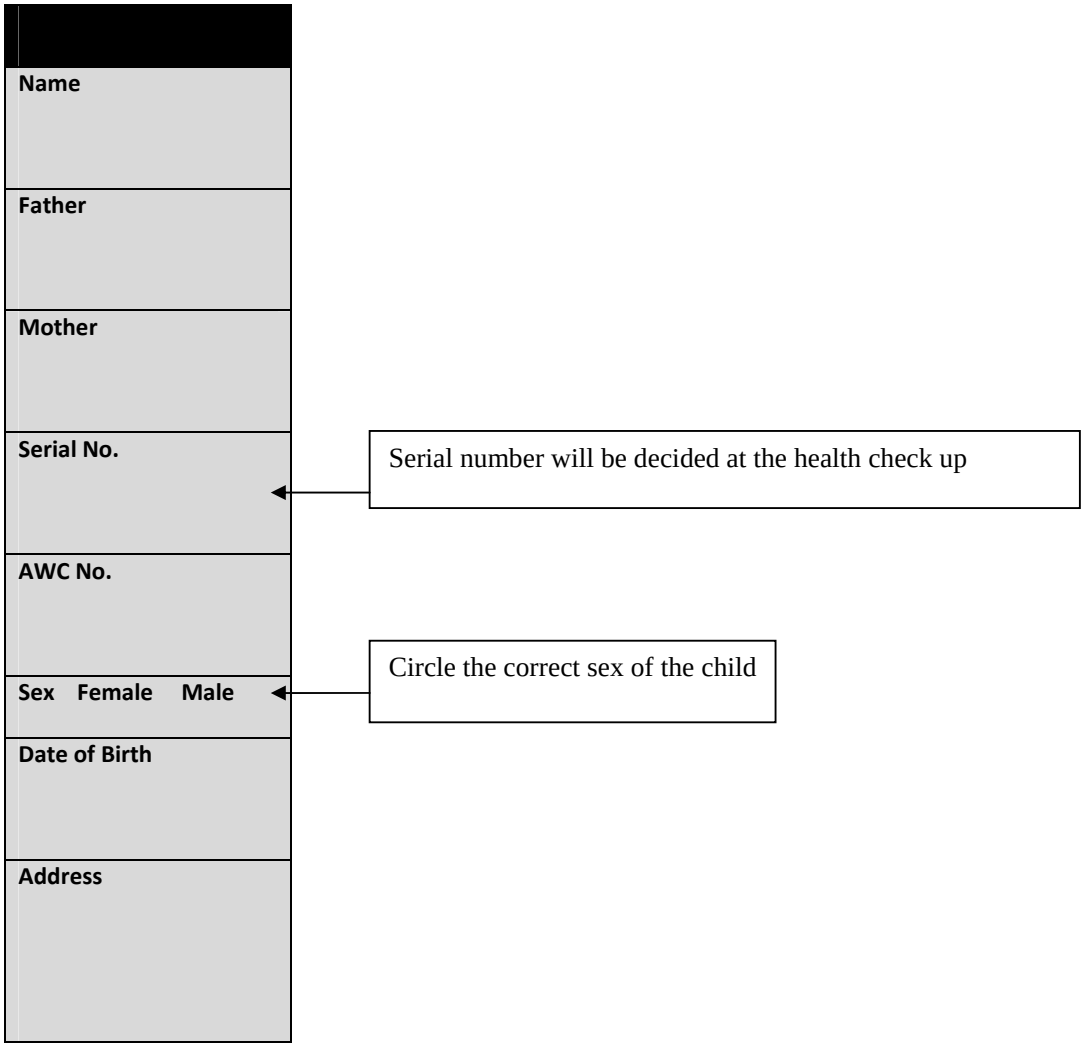
SECTION 2: USING THE HEALTH CARD

Each child in the Anganwadi will be issued a Child Health Card in which all the measurements done during each health check up will be recorded.

Look at the health card now and identify the various sections described below

2.1 Filling out a new health card:

On the first page of the health card, complete the information on the left side of the card:



2.2 Recording the date and age at the beginning of the check up

During each health check up record the date and age of the child in months along the top of the card in the areas indicated below.

HEALTH CHECK UP RECORD				PAGE 1
		CHECK UP 1	**DATE**	**AGE (months)**

2.3 Filling out the measurements and nutritional status

ANTHROPOMETRY
WEIGHT /KG (W)
HEIGHT /CM (H)
M.U.A.C. /MM
OEDEMA YES / NO
W/H Z-SCORE (acute malnutrition)
H/A Z-SCORE (chronic malnutrition)
S.A.M. YES / NO

All the measurements and observations will be recorded in the second column

The next 4 sections describe examining and measuring children.

Please remember to be gentle and kind to the children and their mothers while taking measurements.

Please remember to take measurements carefully because we do not want to miss a child who has SAM.

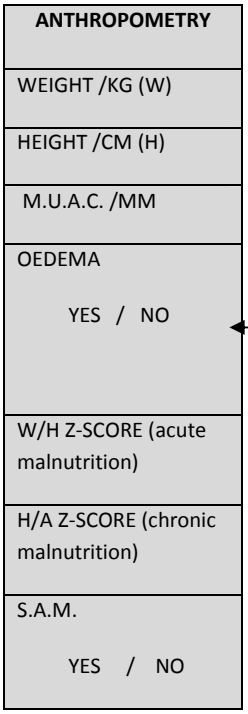
SECTION 3: EXAMINING A CHILD FOR SWELLING OF BOTH FEET

3.1 What you should know about swelling of both feet:

1. Swelling of both feet is a sign of malnutrition.
2. A child with swelling of both feet may have malnutrition even if the child has normal weight and height.
3. A child with swelling of only one foot may have an infection in the foot.

3.2 Steps in examining a child for swelling of both feet

1) Remove the child's chappals/socks
2) Ask the mother to hold the child in her arms
3) Take both feet in your hands
4) Press gently with your thumbs on both feet for 3 seconds
5) Release your thumbs and look for a pit or dent in the child's feet. If there is a pit, the child has oedema
6) Find the box 'OEDEMA' in the health card and circle YES if there is oedema of both feet or NO if there is no oedema.
7) If a child has swelling of both feet tell the mother that the child has malnutrition and needs to be seen by a doctor.



This is where you record swelling of both feet in the card.

3.3 Video of examining a child for swelling of both feet.

3.4 Demonstration

A demonstration will be done on examining a child for swelling of both feet.

Practice examining a child for swelling of both feet.

SECTION 4: MEASURING A CHILD'S WEIGHT

During the check up children will be weighed using an electronic weighing machine.

4.1 What you should know about measuring weight

1) The weight will be shown as a number in the display of the weighing scale.
2) The weight must be recorded to 0.1 kg level of accuracy.
3) The child should stand still without moving on the centre of the scale with the feet slightly apart. No one should hold the child while the child is standing on the scale.
4) Shoes and clothes can increase the weight of the child so these need to be removed before weighing. You need to remove the child's clothes leaving only the underwear.
5) Height will have to be checked quickly after measuring weight. So you need to remove any hair ornaments the child may have or any braids on top of the head because these will artificially increase the height.

4.2 Steps in measuring a child's weight

1) Explain to the mother what you are going to do and the need for weighing the child. .
2) Remove shoes and undress the child
3) Explain to the mother that the clothes and shoes will falsely increase the child's weight.
4) Remove hair ornaments and any braids that may interfere with measuring height.
5) Turn on the weighing scale.
6) When 0.0 appears on the scale ask the child to stand still on the centre of the scale. Explain to the child that they need to stand still.
7) Make sure the child is not moving or holding on to any one.
8) Read the child's weight in the display.
9) Ask the child to get down from the scale.
10) Find the box 'WEIGHT' in the health card and write child's weight to the nearest 0.1 kg.

If the child will not stand still on the weighing scale

1) After undressing the child,
2) Ask the mother to take off her chappals and stand on the scale.
3) Write down her weight.
4) Give the child to the mother while she is still standing on the scale and write down the weight of the child and the mother together.
5) Subtract the weight of the mother from the weight of both the mother and child to get the weight of the child.
6) Record this in the health card to the nearest 0.1 kg.

ANTHROPOMETRY
WEIGHT /KG (W)
HEIGHT /CM (H)
M.U.A.C. /MM
OEDEMA YES / NO
W/H Z-SCORE (acute malnutrition)
H/A Z-SCORE (chronic malnutrition)
S.A.M. YES / NO

This is where you record weight

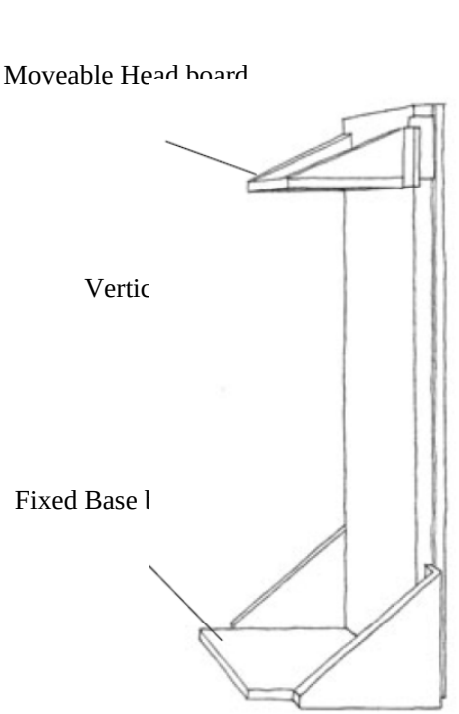
4.3 Demonstration on measuring a child's weight.

4.4 Practice measuring a child's weight.

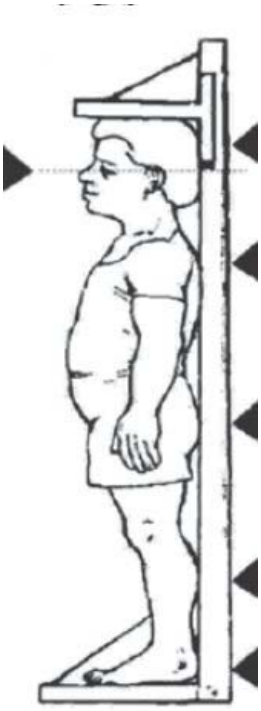
SECTION 5: MEASURING A CHILD'S HEIGHT

During the check up the height will be measured using a height board.

5.1 The Height Board.



The correct position on the height board



Should Touch The Vertical Board

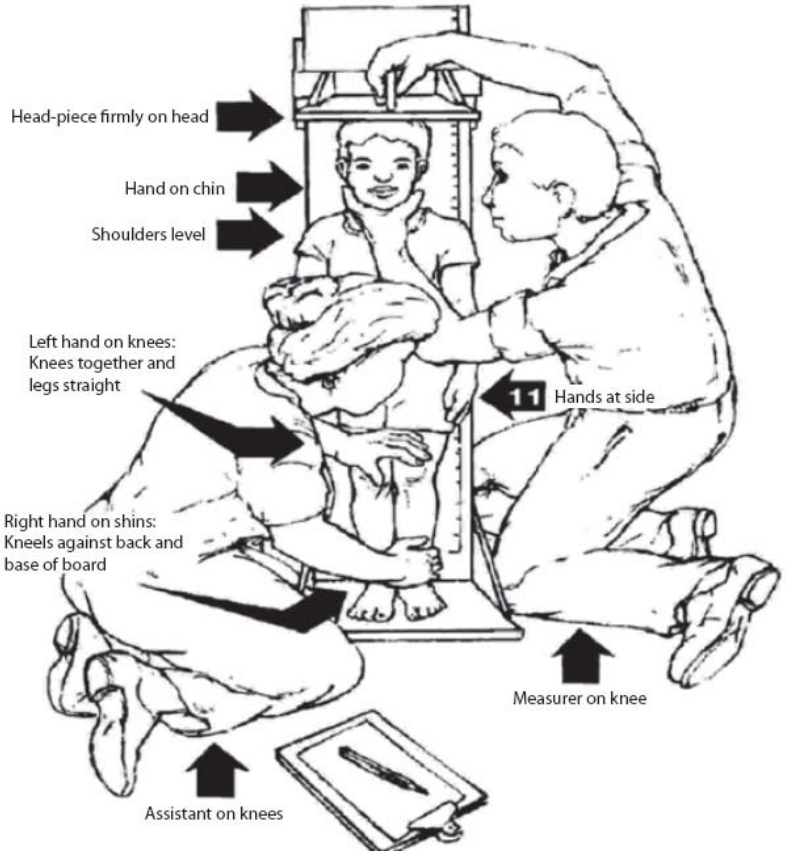
5.2 What you should know about measuring height

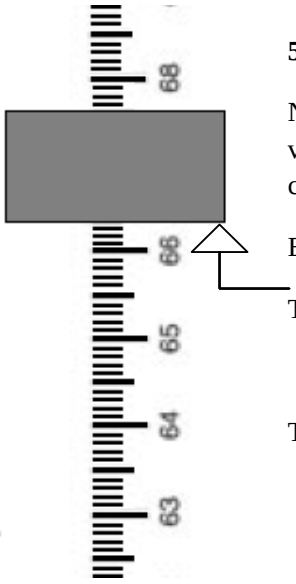
1. Height has to be measured quickly after checking weight.
2. You will need the mother to help you to check height. The child has to stand still and so the mother should calm and soothe the child and fix the child's attention on herself.
3. The correct position of the child on the height board is given in the diagram above:
    a. Feet slightly apart
    b. The back of the head, shoulder blades, buttocks, calves and heels should all touch the vertical board
    c. The head should be straight so that a line from the ears to the eyes is flat and parallel to the base board.
    d. Hands should be at the side
4. Height will be recorded to 0.1 cm
5. If the child is less than 2 years old you should add 0.7 cm to the height which you find.

5.3 Steps in measuring height of a child

1. Check that the child is not wearing any chappals, socks or hair ornaments.
2. Check that the base board is on level ground.
3. Explain to the mother the need for checking height
4. Explain to the mother that you need her help in checking the height.
5. Explain to the mother that the child needs to be still and calm to get a good measurement and that she will have to soothe the child and keep the child calm.
6. Help the child to stand on the base board in the correct position.
7. Ask the mother to hold the child's knees and ankles to keep the legs straight and feet flat with heels and calves touching the vertical board. Ask her to inform you if the child moves out of position.
8. Gently press against the child's stomach to make the child stand straight.
9. With one hand gently hold the head in correct position. Hold the chin between your thumb and index finger and push the head up so that a line from the ears to the eyes is flat and parallel to the base board.
10. Keep the head in position and make sure the rest of the body is in position then with your other hand bring the head board down so that it is firmly against the top of the child's head and compresses the hair.
11. Read the measurement to the last completed 0.1 cm. The last line of 0.1 cm on the scale that you can actually see is the height you should record
12. Record the height in the Health Card. If age is less than 2 years, you must add 0.7 cm to the height you are recording.

Study the picture below to see the correct way of measuring height:





5.4 Written exercise: Reading the height measurement

Now we're going to practice reading the height from the scale on the vertical board. Remember the height of the child is the last complete 0.1 cm that you can see.

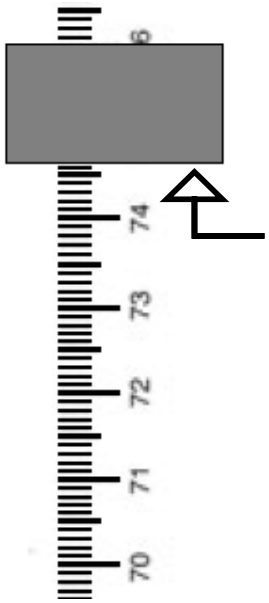
Example:

The child's head comes to this side of the Moveable Head Board

The child's height is 66.3 cm

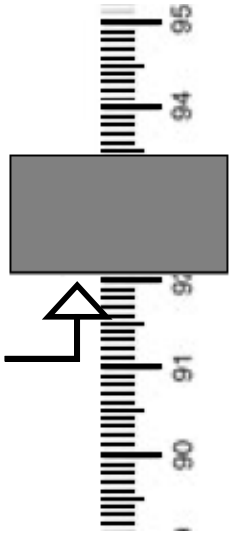
Read the scales below and record the height to the nearest 0.1 cm.

Exercise 1.



Height_____cm

Exercise 2



Height_____cm

5.5 Video on measuring height

5.6 Demonstration of measuring height

5.7 Practice measuring height

SECTION 6: MEASURING MID UPPER ARM CIRCUMFERENCE (MUAC)

6.1 The MUAC tape

Study the diagram of the MUAC tape given below.

Measuring window Out window Strap

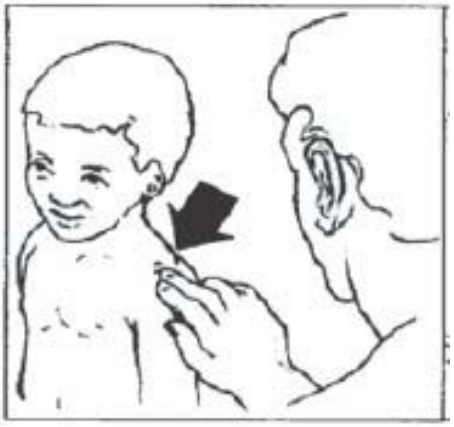
6.2 What you should know about measuring MUAC

1. MUAC is the circumference of the left upper arm.
2. It is measured at the mid point between the shoulder and the tip of the elbow.
3. MUAC is measured for children aged 6 months to 60 months only
4. MUAC is measured in the left arm only.

6.3 Steps in measuring MUAC

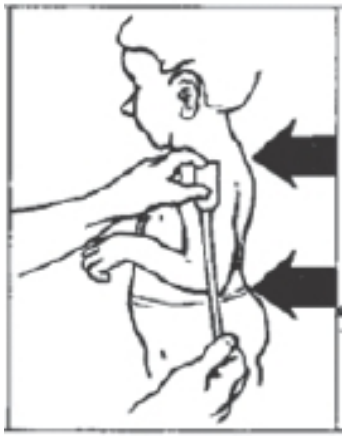
1. Make sure the child's shirt has been removed

2. Find the tip of the left shoulder and mark it with a pen. See the diagram below:

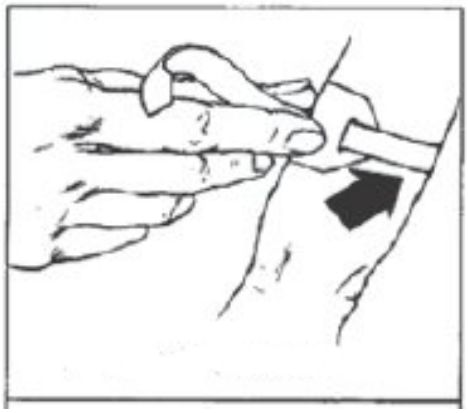


3. Bend the left arm and find the tip of the left elbow and mark it with a pen

4. Use the measuring tape to find and mark the mid point between the tip of the shoulder and the tip of the elbow.

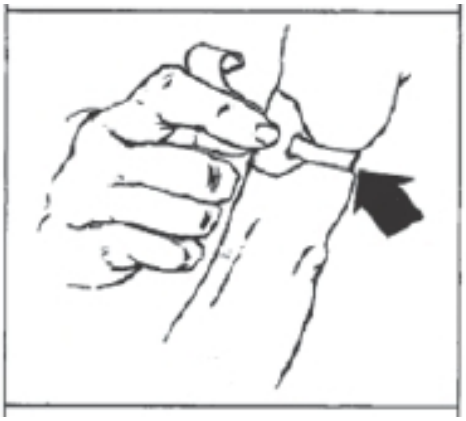


5.With the arm hanging straight down, wrap the MUAC tape around the arm at the mid point mark. Put the strap through the Out window and pull the strap so that the MUAC is flat against the arm. This picture shows the correct tape tension:

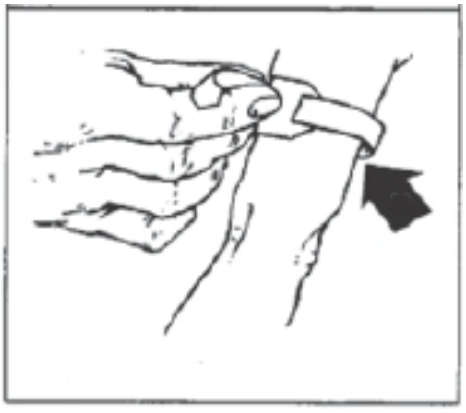


Be careful not to pull the strap too tight or keep it too loose. These pictures show wrong method.

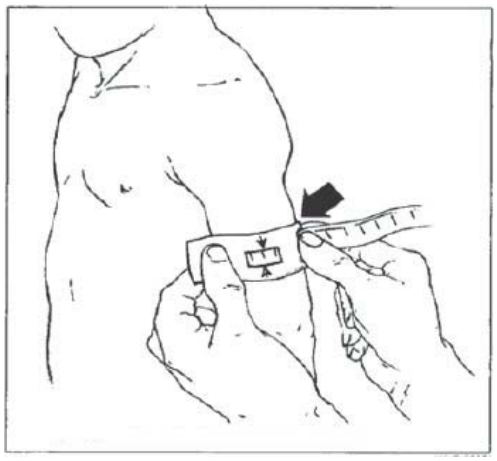
This tape is too tight:



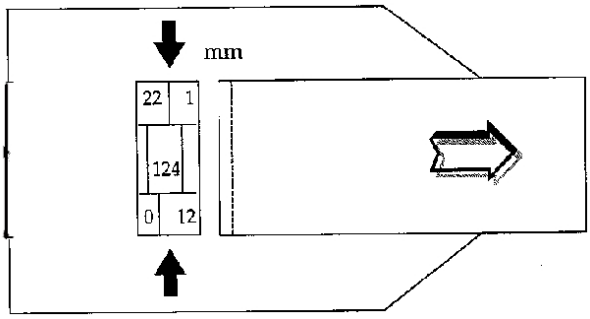
This tape is too loose:



6. Read the Measuring tape through the Measuring window to the nearest 1 mm.



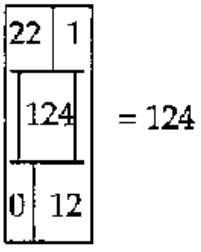
The millimeters will be shown in boxes that you can see through the measuring window:



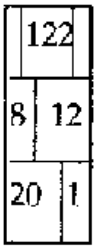
Measuring window Strap

Read the number in the box which is completely visible in the measuring window- this is the MUAC in millimeters.

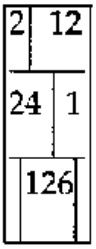
For example:



= 124

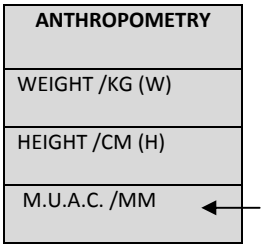


= 122



= 126

7. Record the MUAC in the health card:



This is where you record MUAC.

6.4 Video of measuring MUAC.

6.5 Demonstration of MUAC

6.6 Practice measuring MUAC

SECTION 7: FINDING THE WEIGHT FOR HEIGHT Z-SCORE FROM WEIGHT-FOR-HEIGHT CHARTS

7.1 What you should know about finding Z-score

Weight for Height Z-score is the classification of weight for height that we use to say whether the child is severely malnourished, moderately malnourished or only mildly malnourished.

A score of less than -3 means severe malnutrition

We will find the score by looking at the **Weight-for-height charts**.

Remember that there is a separate chart for boys and girls. Always use only the boys growth chart when measuring boys and only use the girls chart when measuring girls.

Study the charts now and take note of the features.

Sex of the child

Z-score lines

7.2 Steps in finding the Weight-for-height Z-score from Weight-for-height charts

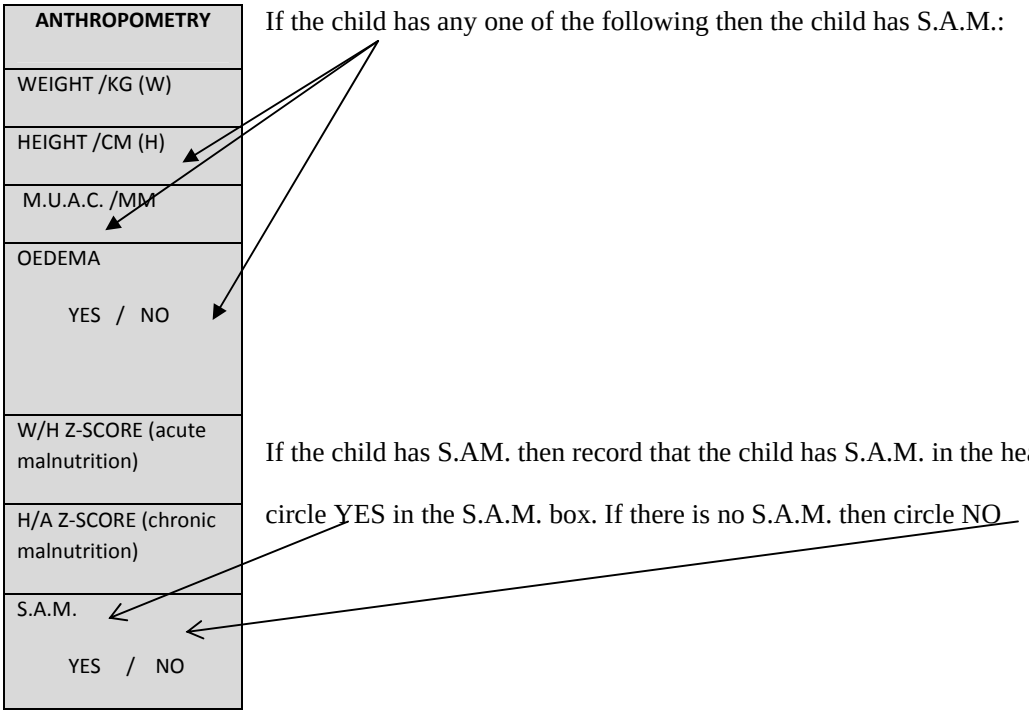
1. Read the height and weight from the health card
2. Mark the point on the graph which corresponds to the child's weight and height
3. See where the mark lies and read the graph to get the Z-score and record it in the health card.
    a. If the mark lies below the -3 Z score line then the score is less than -3 – record as <-3
    b. If the mark lies on any of the Z-score lines then the score is corresponding Z-score line. E.g. if it lies on the -3 line then record the Z-score as -3.
    c. If the mark lies in between Z score lines then the score is from the lower line to the higher line e.g. if the mark lies in between the -2 and -1 line then the score is -2 to -1. Record as -2 to -1
4. Record the Z score in the Health Card.

W/H Z-SCORE (acute malnutrition)
H/A Z-SCORE (chronic malnutrition)
S.A.M. YES / NO

IMPORTANT: If the child's height is less than 65 cm or if the age is less than 2 years you must add 0.7 cm to the height and read the Length-for-weight chart to get the Z-score.

SECTION 8: DECIDING WHETHER A CHILD HAS S.A.M.

Read the anthropometry column of the health card



ANNEXURE 12 KNOWLEDGE ASSESSMENT QUESTIONNAIRE

IDENTIFICATION OF SAM TRAINING PROGRAMME – KNOWLEDGE ASSESSMENT

Select the best option:

1. Severe Acute Malnutrition (SAM) is when:
    a. child loses a lot of weight over a long time
    b. child loses a little weight over a short time
    c. child loses a lot of weight over a short time
    d. child gains a lot of weight over a short time

2. In which age does S.A.M. occur:
    a. from 1 – 12 months only
    b. from 6 months to 60 months only
    c. from 6 months to 6 years
    d. from 6 years to 10 years only

3. S.A.M. is caused by:
    a. inherited from family
    b. breathing bad air
    c. a child having a disease like TB
    d. eating too much sweets

4. Children with S.A.M
    a. Have less risk of dying than children who have the correct weight for height
    b. Have upto 9 times higher risk of dying than children who have the correct weight for height
    c. Have the same risk of dying as children who have the correct weight for height

For the statements circle T if the statement is True, or F if the statement is False.

5. A child has S.A.M. if the child has swelling of both feet	T / F
6. A child has S.A.M. if the child has MUAC less than 115 millimetres	T / F
7. A child has S.A.M. if the child has weight for height Z score more than -3	T / F
8. A child who has S.A.M. need not be sent to a doctor.	T / F

9. Before checking weight, which of the following things should be done? Select the correct options, you can select more than one
    a. Remove the child's shoes and socks
    b. Remove the child's shirt and pant
    c. Remove any hair ornaments that the child may have
    d. The child should pass urine before checking weight

For the following statements circle T if the statement is True and F if the statement is False

10. While checking weight the child should stand in the centre of the scale	T / F
11. While the child is standing on the scale you should hold the child	T / F
12. While checking weight the child should stand still without moving	T / F

13. While checking height which parts of the child should touch the vertical board?
    a. heel, back of head and buttocks only
    b. shoulders and back of head only
    c. heel, shoulders and back of head only
    d. eel, calves, buttocks, shoulders and back of head

14. Where do you measure MUAC?
    a. Right arm only
    b. Right arm or left arm
    c. left arm only

15. Which position should the arm be while measuring MUAC?
    a. The arm should be hanging straight down
    b. The arm should be be lifted above the child's head.
    c. The arm should be bending at the elbow
    d. The arm should be bending at the elbow and lifted up.

ANNEXURE 13: PRACTICAL ASSESSMENT OSPE CHECK LIST

OSPE Check list

Name	Date
Anganwadi Centre No.	Pretest / Post test

1. Examining for oedema

a. Explain to mother/child what they are going to do	
b. Take off shoes	
c. Press feet with thumbs	
d. Press feet for 3 seconds	

2. Measuring Weight

a. Explain to mother/child what they are going to do	
b. Make sure clothes and shoes are removed	
c. Wait for scale to show 0.0	
d. Make child stand on scale in correct position/make child stand with mother	
e. Wait for scale to show weight	
f. Record weight to 0.1 kg	

3. Measuring Height

a. Explain to mother/child what they are going to do	
b. Make sure clothes and shoes are removed	
c. Make sure hair ornaments are removed	
d. Explain to mother what she needs to do	
e. Gets down to child's height	
f. Ensures correct position of child	
g. Brings head board down to child's head	
h. Records height to nearest millimetre	

4. Measuring M.U.A.C.

a. Measures in left arm	
b. Locates and marks the acromion	
c. Bends elbow to find olecranon	
d. Locates and marks olecranon	
e. Locates and marks mid point	
f. Wraps measuring tape at midpoint	
g. Pulls measuring tape to correct tension	
h. Records M.U.A.C. in millimeters	

ANNEXURE 14: DATA COLLECTION SHEET - ANTHROPOMETRY

DATE

ANGANWADI CENTRE NO. AWW NAME Total No. Children enrolled DATA COPY / VALIDATION COPY

Serial No.	Name	Father's Name	D.O.B.	Age (முாத)	Male/ Female பாலினத்தை (M/F)	Oedema வீக்கம்	Weight எடை	Height உயரம்	MUAC மேல்கை நடுக்கை சுற்றளவு	W/H Z-score எடை / உயரம் Z ஸ்கோர்	SAM கடுமையான ஊட்டக் குறைபாடு

ANNEXURE 15: DATA COLLECTION SHEET - DEMOGRAPHY

DATE

ANGANWADI CENTRE NO. ANGANWADI WORKER NAME TOTAL CHILDREN ENROLLED

Serial No.	Name	Father's Name	Father Occupn.	Father Educn.	Mother Occupn.	Mother Educn.	Older Siblings		Younger Siblings	
							Male	Female	Male	Female

ANNEXURE 16: CHILD HEALTH CARD

FREE HEALTH CHECK UP OF PRE SCHOOL CHILDREN (2-5 YEARS) IN ANGANWANDI CENTRES IN VELLORE (URBAN) PROJECT

JOINTLY ORGANISED BY INTEGRATED CHILD DEVELOPMENT SCHEME AND COMMUNITY HEALTH DEPARTMENT CMC VELLORE.

HEALTH CHECK UP RECORD			PAGE 1
Name	CHECK UP 1	DATE	AGE (months)
	ANTHROPOMETRY	MEDICAL ASSESSMENT	
	WEIGHT /KG (W)	COMPLAINTS	
Father	HEIGHT /CM (H)	VISION	EYES
Mother	M.U.A.C. /MM	PALLOR YES / NO	VITAMIN DEFICIENCY
Serial No.	OEDEMA YES / NO	HEARING	EARS
AWC No.	W/H Z-SCORE (acute malnutrition)	NOSE AND THROAT	DENTAL AND ORAL
Sex Female Male	H/A Z-SCORE (chronic malnutrition)	SKIN	MUSCULOSKELETAL
Date of Birth	S.A.M. YES / NO	CVS	RS
Address	**DEFINTION S.A.M.: W/H Z SCORE < -3 AND/OR M.U.A.C. <115 mm AND/OR Bilateral oedema**	ABDOMEN	GROSS MOTOR
	DIAGNOSIS		OTHERS
	TREATMENT/REFERAL DEWORMED YES / NO		FOLLOW UP